THURSDAY, JULY 17, 1879

RECENT PUBLICATIONS ON GALILEO'S TRIAL BEFORE THE INQUISITION

Galileo Galilei and the Roman Curia, from Authentic Sources. By Karl von Gebler. Translated with the Sanction of the Author by Mrs. George Sturge. (London: C. Kegan Paul and Co., 1879.)

Der Process Galilei's und die Jesuiten. Von Dr. F. H. Reusch, Professor an der Universität in Bonn. (Bonn, 1879.)

La Question de Galilée: les Faits et les Conséquences. Par Henri de l'Epinois. (Paris et Bruxelles, 1878.)

Encore Galilée! Polémique—Histoire—Philosophie. Par le P. Eugène Desjardins, de la Compagnie de Jésus. Seconde Édition. (Paris, 1877.)

IN presenting us with an English translation of Karl v. Gebler's "Galileo," Mrs. Sturge has conferred an unquestionable boon on those who, without caring to pursue the subject in Continental publications, wish to obtain a fairly complete view of the relations between the Florentine astronomer and the authorities of the Roman Church, as seen in the light of the most recent researches. The original,[1] which appeared in 1876, was chiefly remarkable for its happy selection of just so much documentary and collaterally illustrative matter as sufficed to render the whole drama of Galileo's conflict for the Copernican theory, in its most authentic form, at once accessible to every educated German reader. The English public are now, thanks to Mrs. Sturge's labours, placed in an equally, indeed an even more, favourable position. To explain how this has come about, it is necessary to refer for a moment to circumstances which preceded the early and lamented death of the German author in September 1878.

One of the topics discussed in the greatest detail by v. Gebler in 1876 was a particular order of the Inquisition purporting to have been delivered to Galileo in 1616 by the mouth of its Commissary-General. He then held very decidedly—following the footsteps of Wohlwill in Germany, and of Gherardi in Italy—that the order in question never reached Galileo at all, and that a minute in the Vatican manuscript, purporting to report its delivery, was a forgery effected for the most sinister objects in 1633. A subsequent controversy with Prof. Berti determined v. Gebler to apply for permission to examine the original manuscript record of the trial preserved in the Vatican Archives, in order to satisfy himself by personal inspection as to the disputed point. His application, powerfully supported by the Austrian embassy at Rome, was acceded to by the Papal authorities. As the result of an investigation made in the summer of 1877, he declared himself satisfied that the disputed entry in the trial record was *not*, as he had till then maintained, a forgery, but a genuine document of the year 1616. In spite, however, of this frankly avowed change of opinion, he firmly adhered to his previously expressed convictions that Galileo had not been served with the order of the Inquisition, and that therefore the minute asserting the contrary, though genuine, stated what was inherently false. It is obvious that, had the author been called upon to prepare a second edition of his "Galileo," his changed attitude towards the forgery-question would have compelled him to effect considerable alterations in many passages of the work. This revision was, however, not destined for his hands. A predisposition to lung-disease had been fatally aggravated by ten weeks of the very heaviest literary labour, undertaken in preparing his admirably complete edition of the Vatican MS., and passed in the dangerous atmosphere of a Roman summer. He returned home greatly reduced, but had still strength to make, a few months later, a short tour among the principal cities and places historically connected with the life and memory of Galileo. On September 7, 1878, he succumbed to his incurable malady, at the early age of twenty-eight.

The reader will now be in a position to see that the preparation of an English version of v. Gebler's work presupposed a revision such as its author, had he lived to effect it, must necessarily have carried out. This task has been most judiciously performed by Mrs. Sturge, though on her title-page she modestly abstains from taking credit for it. In addition to making such alterations as the author's change of view directly entailed, she has brought the work abreast of the very latest research, and supplied in an appendix a short series of documents exactly co-extensive with the wants of the general reader as distinguished from the specialist or professed historical student. The work of translation is done with much fidelity and in a way to show that Mrs. Sturge has gone far beyond the tether of the mere translator and grasped the inner significance of the events which she had to clothe in an English dress. Her volume is not immoderately large, and its print and general appearance do credit to its enterprising publishers. While, however, this important contribution to Galileo-literature in England is thus entitled to a very hearty welcome, it contains a few minor blemishes which it may be well in conclusion just to indicate.

The translation is occasionally verbally inaccurate Thus *die Acten des Processes* is systematically rendered the "Acts" instead of the "Records" of the Trial. At p. 8 we read of Galileo's "intellectual" (instead of 'clever' or 'ingenious' = *geistreich*) "treatment of physics." On p. 46 "*in seinem betreffenden Schreiben*" is translated "in his striking letter," where the real meaning is of course "in his letter referred to." At p. 272 it is said that Galileo had better beware of the Holy Office, whereas in the original the word *Jene* shows that *other* persons were meant. "*Ex suppositione*" is translated "as a conjecture" (p. 203), where "assumption" is obviously the proper equivalent.

In the English version of a Latin document (p. 78) the original of which is given in a note on the same page, the corrupt reading "Rottz" displaces the right reading "Rose." Further, "Augustino" and "Mongardo" appear as nominative cases, and "*dioc. Politianen*" is rendered diocese of "Politianeti" instead of "Montepuleiano."

The title of Prof. Reusch's volume might easily lead one to expect some further elucidation of the oft-mooted question to what extent the measures taken against Galileo were instigated by the Jesuits. It turns out,

[1] Reviewed in NATURE, vol. xiv. p. 226.

however, that nineteenth, not seventeenth, century Jesuits are the main objects of the writer's animadversion. Certain Fathers of that Order have recently made elaborate attempts to whitewash and even decorate the Inquisition at the expense of its illustrious victim, and it is to these that their well-known "Old Catholic" opponent now calls hostile attention. The attack on these writers, however, occupies only a comparatively small portion of the work, and will be best noticed further on. Its bulk is made up of a laboriously complete collection of historical matter bearing on Galileo's trial, and of detailed disquisitions on every question of importance flowing from that perennial source of interminable controversy. Prof. Reusch claims for his book that it should be regarded not as "merely an improved and enlarged edition of that of v. Gebler," but also as containing a detailed examination of a question which the young Austrian writer was "not theologian enough thoroughly to discuss," viz., "What do we learn from the condemnation of the Copernican doctrine in 1616, and from the sentence on Galileo in 1633, in reference to the authority claimed at Rome for the decision of theological and quasi-theological controversies?" It will thus be seen that the author's main object is practically an anti-infallibilist polemic, into the merits of which it would be improper to enter here. In the few criticisms now to be made on his work I shall limit myself strictly to its historical and literary side.

The volume before us—a closely-printed quarto of 482 pages—is assuredly entitled to be called an "enlarged" edition of v. Gebler's work, but its author's claim to have also "improved" on the labours of his predecessor seems, in one important respect, open to serious question. Von Gebler, it will be remembered, while conceding the genuineness of a particular document, stoutly maintained to the last that *its contents were essentially false*. Reusch argues that the document is genuine, and *its contents true*. His view on this crucial question is therefore opposed to that of the writer whose work he is "improving," and its substitution for the position deliberately reaffirmed by v. Gebler cannot be recognised as a process of "improvement" until the formidable series of arguments in support of that position constructed by Wohlwill and Gherardi, and very fully set out in the pages of v. Gebler himself, have been essentially invalidated. Into the details of our author's elaborate attempt to supply such an invalidation space forbids me to enter. I can only express my personal opinion that it is based on unsupported conjectures more inherently improbable than the closely concatenated inferences which he labours to overthrow. In spite, moreover, of his zealous and conscientious efforts in the collection of illustrative materials from every possible quarter, the result is marked by a diffuseness and a want of orderly arrangement which are only too likely to exhaust an ordinary reader's whole stock of patience long before he reaches the conclusions to which this formidably extensive pile is designed to lead up. Prof. Reusch's reasoning itself is somewhat ponderous, and shows but little trace of the eager perspicuity which lends such coercive force to the arguments of his chief opponent, Wohlwill.

The most telling part of his book undoubtedly is his attack on the modern Jesuit commentators already referred to, in which our author's hearty detestation of crooked literary practices comes out with refreshing vigour of expression. He points with indignation to their systematic efforts to aggravate the dark spots in Galileo's private life, the weak points of his character, and other like matters of little or no bearing on the main issue; he reprehends their attempts to minimise or explain away the harsh dealings of the Holy Office with its illustrious prisoner; he condemns their inveterate habit of backing up untenable positions by misleading citations and even downright garbling. As an instance of the astounding length to which these advocates are prepared to go in the defence of their *thesis* he quotes the statement of Grisar to the effect that Galileo's judges "could not have had the faintest suspicion" that he would be unable to give a conscientious assent to their decision. When the same writer goes on to justify this assertion on the ground of the humiliating expressions of self-abnegation used by the unhappy prisoner during his examination under the paralysing influence of fear, it is certainly, as Reusch himself remarks, "difficult, even for a Jesuit, to write anything more Jesuitical."

It is much to be regretted that in anything coming from the pen of one who has done such good service to the cause of Galileo literature as has M. Henri de l'Epinois, arguments should be found presenting even a superficial resemblance to those so justly denounced by Prof. Reusch. Certainly, however, his latest popularly written little account of Galileo's trial contains statements and inferences of a kind to make one hope that they may have been admitted into its pages on trust from other writers without passing the author's personal scrutiny. I must justify this remark by reference to particular instances.

One of the strongest pieces of evidence on the side of Wohlwill and his school is a certificate written by Cardinal Bellarmine in 1616, stating that only the declaration of the Index Congregation with regard to the Copernican doctrine had been communicated to Galileo. The whole force of the document depends on the word *only*. M. de l'Epinois, in giving an account of the hostile argument founded on this document (p. 227), summarises its contents so as to omit this pivot-word altogether.

On the following page, Bellarmine's having used words which by implication excluded the delivery of a stringent personal injunction to Galileo is toned down into his having "said nothing about" this injunction.

On p. 229 the fact of an unsuccessful search having been made in the Vatican archives for a particular missing document is described as resting only on vague report (*dit on*), whereas since the appearance of v. Gebler's edition of the trial-record in 1877, we know that the fact was officially vouched for by the Cardinal Secretary of State himself.

In endeavouring to prove (p. 250) that the Commissary of the Inquisition did actually deliver his injunction in 1616, M. de l'Epinois says that it never occurred to Galileo to deny the fact in the course of the proceedings of 1633. He lays stress on the admission of the accused that Dominican monks were present during the interview with Bellarmine, one of whom may have been the Commissary, but omits to mention Galileo's affirmation that they said nothing to him, and that he did not know who they were. He emphasises the fact that the written defence of the accused admitted the reception of an order

from the Inquisition, but passes over in silence Galileo's perfectly explicit declaration that the order in question had come to him through no other person than Cardinal Bellarmine. Any one who knows how different are the parts assigned in the Vatican manuscript to the Cardinal and to the Commissary will see at a glance the serious nature of this last omission.

On p. 231 an argument is advanced, the futility of which one would have thought must have been obvious to the possessor of the most elementary knowledge about inquisitional suits in general, and that of Galileo in particular. M. de l'Epinois expresses astonishment that Galileo, if he was really conscious of having been condemned on a trumped-up charge, should not have left behind him, in letters to his friends, some protest against the abominable act of fraud of which he had been the victim.

Now, in the first place, it was the regular practice of the Inquisition to exact from those who appeared at its bar an oath of absolute silence, under pain of excommunication in case of contravention, as to everything which had occurred within the sacred tribunal. We know from the Vatican MS. that this precaution was taken in the case of Galileo. Further, the sentence of 1633 menaced him with being treated as a relapsed heretic (*i.e.* burned alive) if he should venture to treat of his condemned opinion of the earth's motion in any manner whatever. Lest it should be supposed that this was a piece of mere formality, the Inquisitor of Florence, during Galileo's subsequent practical imprisonment in his own villa at Arcetri, threatened him in the most unmistakable language with immediate incarceration in the actual dungeons of the Roman Inquisition if he should dare to propagate in conversation the Copernican doctrine.

It requires, then, little prophetic gift to foresee what would have befallen Galileo had he been detected setting in circulation a charge of the blackest fraud against the supreme tribunal of the Inquisition. His silence on the subject can cause those who believe in the reality of this fraud no astonishment whatever. The only surprise they are likely to experience is that a writer so exceptionally acquainted with the details of Galileo's case as is M. de l'Epinois, should have esteemed an argument of this kind worthy of a place in his pages.

I cannot think that M. de l'Epinois is more successful in setting up a positive theory of his own than he is in demolishing that of Wohlwill. He maintains a thesis favourable to the Roman authorities, but it is based on efforts to explain away, or assert away, palpable contradictions, and on gratuitous and mutually destructive assumptions. In short, his whole treatment of the issue essentially in dispute is both superficial and unsatisfactory.

Father Desjardins, of the Society of Jesus, tells the world that, inspired with sacred boldness (*de saintes audaces*), he has torn from the hands of the Church's enemies a weapon of which they had made sinister use, by restoring to the incident of Galileo so long travestied by ignorance and bad faith, its veritable physiognomy. His preface concludes with the following piece of advice to such of his readers as may be disposed to criticise the acts and institutions of the Roman Church in this or any other case:—

"Approve everything without hesitation, and soon philosophic examination will reward your confidence by presenting to you a complete demonstration of all these things!"

Such a maxim is so little likely to find favour with readers of NATURE that I shall trouble them no further with the magniloquent Jesuit's production which is as superficial, arrogant, and inconclusive as its pompous exordium would lead one to expect.

In terminating this notice it may be as well to remark that the question whether Galileo was or was not fraudulently convicted and condemned remains still undecided. The Roman authorities have not as yet taken the one step which offers some chance of settling, and could hardly fail essentially to narrow, the issue. This consists in allowing free access to, and facsimile reproduction from, all and every portion of the Vatican MS., instead of restricting, as appears hitherto to have been done, this privilege to members of the Roman Church supported by ambassadorial or episcopal recommendations.[1]

SEDLEY TAYLOR

THE MANUFACTURE OF SULPHURIC ACID AND ALKALI

A Theoretical and Practical Treatise on the Manufacture of Sulphuric Acid and Alkali with the Collateral Branch. By George Lunge, Ph.D., F.C.S., Professor of Technical Chemistry at the Federal Polytechnic School, Zurich (formerly Manager of the Tyne Alkali Works, South Shields). Vol. i. (John van Voorst, 1879.)

WE heartily welcome Prof. Lunge's volume on the manufacture of sulphuric acid. It is the result of a rare combination of thorough knowledge of scientific theory with that intimate experience of the practical manufacture which can only be gained by those who come into daily contact with the problems presenting themselves in dealing with chemical operations on a large scale.

In his preface our author distinctly states the object he has in view, and very modestly but clearly indicates the claims upon which he founds his right to speak: "The present treatise," he says, "is intended to supply various wants, and accordingly appeals to various classes of readers. In the first place, it gives a scientific description of all the substances occurring in the manufacture of sulphuric acid, alkali, and bleaching powder, either as raw materials or finished products, according to the most recent statements. Secondly, it is intended as an aid in the study of technical chemistry by giving a complete description, both technical and theoretical, of all the processes occurring in this series of manufactures. Its third and principal object is to give to practical manufacturers both complete and reliable information upon all the apparatus and processes which have come under the author's notice. . . . Much space is taken up by the discussion of the innumerable publications in English, German, and French, referring to this industry, but even more space was required for the faithful rendering of the author's personal observations and experiences. His own practice of eleven years in the north of England has been

[1] Wolynski. Nuevi documenti inediti del Processo di Galileo Galilei Firenze, 1878, p. 13.

supplemented by numerous visits to other alkali-manufacturing districts of Britain and the Continent. The author's present position as professor at a technical high school enables him to state frankly what he knows and what he has seen, since he can expect no benefit from keeping anything back."

Every one who reads the volume before us will feel that Prof. Lunge has admirably succeeded in the serious task which he has set himself to accomplish, and there is no doubt that he has thus not only filled up an important lacuna in our chemical literature—for in no sense can any other existing work on the subject be said to be satisfactory—but he has given us a work which must become a standard one.

The importance and magnitude of the British sulphuric acid trade will best be understood when we remember that cheap glass and cheap soap—or light and cleanliness—depend upon the cheap production of oil of vitriol; and when we learn that Great Britain manufactures about five-eighths of the production of the world, and that the annual amount made in this kingdom now reaches the enormous figure of 832,000 tons.

Nor is it in quantity alone—although that is, after all, the true measure of a successful trade—that the English manufacturers stand pre-eminent. In all the great improvements which have taken place, England has fully held her own with her perhaps more highly-educated Continental rivals. Thus, although the introduction of pyrites in place of brimstone is often accorded to Messrs. Perret of Chessy, in 1835, there is no doubt that Mr. Hill of Deptford patented the process in 1818, whilst the first to employ pyrites on a large scale was Thomas Farmer of London. Passing again to the mechanical devices for burning pyrites, we find that Dr. Lunge gives an unfavourable opinion as to the construction and mode of working of the Continental burners, and acknowledges that the English form is that which yields the best results, and is now being largely introduced in both France and Germany.

Then, again, as regards the construction of the now all-important leaden chamber, we find that an Englishman, Dr. Roebuck of Birmingham, was the first to erect such a chamber in 1746. And if it is to the genius of Gay-Lussac in 1827 that we owe the idea of the recovery of the excess of escaping nitrous fumes, by passing the exit gases through a shower of strong sulphuric acid, we must remember that this part of the manufacture was not perfect until Mr. Glover proposed the addition of his denitrating tower. All these, and many other inventions and appliances made by intelligent English manufacturers, are clearly stated by Dr. Lunge, who appears to be perfectly free from bias, and discusses the whole subject with a thoroughly scientific spirit. Our English system of Government inspection of sulphuric acid works also comes in for a proper share of notice and commendation, although we do not find mention made of the labours of the recent Noxious Vapours Commission, founded upon whose report the Government have brought forward a new Noxious Vapours Act, which is to include a large number of works, especially vitriol works, which as yet are not placed under inspection. Several of the various proposals which have been made by the chief inspector, Dr. Angus Smith, and his staff, are dwelt upon. Especially we would notice Fletcher's valuable anemometer for the measurement of the draught in flues and chimneys, upon the results of which the escapes of acid are ascertained.

Dr. Lunge has lived so long amongst us that he not only fully appreciates highly our manufacturing skill, but he is able to express his appreciation in terse and luminous English. The illustrations, too, with which the volume teems are of the highest excellence, drawn, as they all appear to be, to scale, and engraved with the care and precision which is characteristic of the great publishing house of Vieweg and Sons of Brunswick. From whatever point of view we consider his labours, there is no doubt that they will be highly valued both by students and manufacturers, and we can confidently recommend this first volume of Dr. Lunge's work to all those who, from the scientific or from the practical side, are interested in this most important chemical manufacture.

H. E. ROSCOE

OUR BOOK SHELF

On the Origin of the Laws of Nature. By Sir Edmund Beckett, Bart. (London: Society for Promoting Christian Knowledge, 1879.)

THIS is a very clever little book, and deserves to be widely read. Its subject, however, is scarcely one for our columns. For it is essentially "apologetic," and its strong point is not so much accurate science as keen and searching logic. It dissects with merciless rigour some of the more sweeping assertions of the modern materialistic schools, reducing them (when that is possible) to plain English so as to make patent their shallow assumptions. When, from the inherent vagueness of a statement, the author finds himself unable to present it in intelligible and simple language, he gives by apt analogy a clear view of its absurdity. He follows out in fact, in his own way, the hint given by a great mathematician (Kirkman) who made the following exquisite translation of a well-known definition :—

"Evolution is a change from an indefinite, incoherent, homogeneity to a definite, coherent, heterogeneity, through continuous differentiations and integrations."

[*Translation into plain English.*] "Evolution is a change from a nohowish, untalkaboutable, all-alikeness, to a somehowish and in-general-talkaboutable not-all-alikeness, by continuous somethingelsifications and sticktogetherations."

The following quotations, taken almost at random, give a fair idea of the style of the book :—

"You may say perhaps that this is just Hume's famous argument against miracles, viz. that all experience is against them, while lying is not at all contrary to experience. But that again is a mere paradox, or a verbal trick which either begs the question or is absurd. For if by 'all experience' he meant literally all experience, that simply begs the question; and if he meant only general experience, it sinks into the platitude that miracles are uncommon. Again, if the prevalence of lying were a sufficient reason for disbelieving any extraordinary story, then we must not believe that any extraordinary event ever happened: which is absurd."

"In that respect there is no difference between a single atom and that congeries of atoms which for the time makes up a man: at any rate atheistical philosophers admit none: according to them it is matter (*i.e.* the atoms of it) 'that has the promise and potency of life,' and man is only a machine resulting from their spontaneous action under laws and forces which always existed without any cause. But if the most determined man in

the world resolves ever so firmly to walk to a place a mile off, that initial resolution will never get him there unless he further resolves at every moment of his walk to take the next step, and takes it."

"... Atheistic philosophers are always insisting on the fact that whatever powers have made the world, have made it and kept it going and improving by means of nvariable laws or modes of action. Then if uniformity of action *of the proper kind* can do the business so well, why should it be varied? This argument against a creative will in other words asserts that there can be no such will because the plan and rules by which it uniformly acts are so good that they have never to be varied in order to repair a single defect or produce a single improvement; *i.e.* 'there is no creator and maintainer of the world because the design was so perfect. If we had seen the universal machine working by fits and starts we should certainly have admitted that every one of them involved a fresh application of power; but we deny any because it works so smoothly that it seems to go of itself, though it is always turning out products of infinite variety, and in some respects continually improving.' Such an argument as that only needs stating nakedly to answer itself. .... A machine that will go on for ever producing ever-varying and ever-improving results is manifestly and infinitely superior to one that needs continual interference, and implies infinitely greater wisdom in the maker of it."

"... the leaders of the materialistic school give us such dogmatic statements as that 'materialism is the best working hypothesis,' and that 'it is a fundamental law of psychology that all beliefs as to the past and the present must rest on experience.' But they neither pretend to prove that 'fundamental law,' nor to tell us who made it, except themselves, nor why a hypothesis is the best working one which explains nothing, but merely asserts, when turned into plain English, that things are because they are; and that mind is only the result of certain motions of matter, without professing to explain how a single particle of matter came to be able to move itself .... all this language of the materialists or atheists, or sceptics, or whatever else they call themselves, is not demonstration but mere assertion, which could just as well be made the other way."

When the purposely vague statements of the materialists and agnostics are thus stripped of the tinsel of high-flown and unintelligible language, the eyes of the thoughtless who have accepted them on authority (!) are at last opened, and they are ready to exclaim with Titania

Methinks "I was enamour'd of an ass."

As the touch of Ithuriel's spear at once happily revealed the Deceiver, these frank and clear exposures of the pretensions of pseudo-science cannot fail of producing great ultimate good. P. G. TAIT

The Home of the Eddas. By Charles G. Warnford Lock. With a Chapter on the Sprengisandr by Dr. C. Le Neve Foster. (London: Sampson Low, Marston, and Co., 1879.)

ANOTHER volume of Icelandic travel has been added to the lengthy series which already loads the book-shelves of those who are interested in that wonderful country of frost, and flood, and fire. More than fifty such works have been published during this century; some discussing the geology, others the natural history of the country; others the characteristics of the people, and of their literature; many are simply records of travel, some are mere clumsily-constructed diaries. We fear we must class the volume before us among the latter. It is a mere diary, and in good sooth the most intolerably dull diary we ever read. We have searched in vain for any new facts, any new views concerning old facts, any local and individual colouring. The author has travelled over old ground, by the old methods, permeated by the ideas of his predecessors. Let us, however, give him his due. He is a brave man, and a contented man. Never were dangers more pluckily faced; never did a man grumble less under the most trying circumstances. Many men with less perseverance, less hardihood, less indomitable spirit, have made considerable discoveries, achieved great results. He travels twelve or twenty hours at a stretch in midwinter; he fords foaming torrents; traverses treacherous bogs; crawls all-fours over ice-slopes; puts up with the most miserable accommodation and food, and yet is always cheerful, and always makes the best of things. Often he gets soaked to the skin in a glacier river, and has to sleep in his wet clothes in a pestilential baðstofa. Often after a weary day's march he has to go supperless to bed. That all his labour should have resulted in so little—we fear we must say, in no—gain to art, literature, or science, is quite deplorable. But the fact is, records of Icelandic travel are worn threadbare. More than fifty years ago the works of Mackenzie and Henderson appeared; less than four years ago the two-volumed "Ultima Thule" of Capt. Burton gave us the most recent experiences of an accomplished traveller. For a general description of the country we still prefer Henderson; Baring-Gould's "Scenes and Sagas" furnishes a pleasant, chatty volume of travel, full of north-world lore; while Prof. Bryce's "Impressions of Iceland," in the *Cornhill Magazine* for May, 1874, is the very type of a well-written general article on the subject; full of condensed observation, wide in limit, admirable in style, masterly in treatment. One thing could have partially redeemed "The Home of the Eddas" from its dull monotony: had it been well illustrated with views not commonly met with in Icelandic works of travel, it would have been a redeeming point. But, alas, there is not a single illustration.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.*

[*The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to ensure the appearance even of communications containing interesting and novel facts.*]

Swift's Comet

THE following position of the comet was obtained from three comparisons with the star *Dm* + 84°, No. 60. From a single comparison of the star with *Carrington* 447, the declination of the *Dm* appears to require the correction − 8″, but I have not applied it to the comet's place. The declination of the ephemeris of the comet, in NATURE, vol. xx. p. 248, requires a correction of only + 0′·6.

1879.	G.M.T.	App. R.A.	App. decl.
	h. m. s.	h. m. s.	° ′ ″
July 10 ...	11 14 12 ...	2 57 37 ...	+84 54 0

1, Vanbrugh Park, Blackheath, S.E. G. L. TUPMAN

Hissarlik

I SEE in NATURE, vol. xx. p. 255, a statement, which has also appeared in the *Times*, that Prof. Virchow has written to my friend, Dr. Schliemann, stating that there is a concurrence of geological opinion in Berlin that all the building stones, fragments of which the professor brought home from Hissarlik, are of fresh-water formation. This conclusion it is said is thought to be decisive against those who affirm the impossibility of identifying Hissarlik with the Homeric Troy on the ground that at the time of the great epic, the site must have been covered by the sea. I am, however, unaware that it has ever been argued that the actual site of Hissarlik was covered by the sea, but only that Hissarlik was probably on the sea-shore, a position which would be quite inconsistent with the statements of Homer. I have never committed myself to this opinion, but I

may be allowed to point out that the fact mentioned by Prof. Virchow favours rather than disproves this view. If the plain between Hissarlik and the sea has been gradually formed by the detritus brought down by Scamander the materials would be of fresh-water origin. The observations made by Dr. Virchow appear therefore to me by no means to bear out the conclusions whichit is said, have been drawn from them.

15, Lombard Street, E.C., July 12 JOHN LUBBOCK

On the Origin of Certain Granitoid Rocks

DR. HICKS has very properly called attention to his prior discovery of the transitional nature of some hälleflintas, and I regret that I overlooked this point in his valuable papers on the Pembrokeshire rocks. I may, however, be permitted to point out that my observations in Shropshire go further than those of Dr. Hicks, since the hälleflinta observed in the Wrekin range passes not merely into "incipient gneiss, the metamorphic action being incomplete, a kind of semi-metamorphism and softening having taken place, etc."; but into a true gneiss, distinctly foliated in bands of quartz, felspar, mica, and sometimes hornblende, and into granitoidite and granite. In the Wrekin we see the completion of the change of which Dr. Hicks recorded the earlier stages. C. CALLAWAY

Wellington, Salop, July 12

The Telephone

EXPERIMENTS that I have recently made with a "Bell" telephone have convinced me that the sounds produced are the result of molecular change in the iron disk, and are the same in kind as those heard in the telephone of Reiss.

My experiments were made with a carbon transmitter and Bell receiver, using a small battery to generate the current. First I removed the bar magnet from the receiver, in accordance with a suggestion made by a writer in NATURE some months ago. The effect without the magnet was the same as with it. It then occurred to me that the intensity of the sound might be increased by using two disks instead of one. Accordingly I cut two circles out of a piece of sheet iron, leaving a narrow strip of the metal to connect them, of sufficient length to enable the disks to lie on either side of the reel, so as to form, in fact, an armature to the electro-magnet. On experimenting with this my anticipations were fully realised, the sound produced being more than double that from a single disk.

Now, while trying these experiments I held the disks loosely in my hand, without their being in any way fastened to the wood holding the reel, the effect being the same as if firmly secured. In fact, a common dinner knife or a rough piece of iron would emit sound if brought near enough to the core of the electro-magnet.

I have since constructed a very efficient telephone receiver out of a block of wood two inches square and three-quarters of an inch thick. I then drilled a hole sufficiently large to receive the reel, and covered the block with thin sheet iron. It needs no ear-piece, and forms the most effective telephone receiver that I have seen. But, still further to prove that the sounds produced are due to the magnetisation of the iron of the disk, and not to mechanical vibrations resulting from the electro-magnet, I made an iron reel, the flanges of which were two inches in diameter. Now, on covering this reel and placing it in circuit, the flanges of the reel gave out sound as clearly as in the Bell telephone. In my judgment this experiment renders it conclusive that the sounds proceed from the magnetisation and demagnetisation of the iron, and are therefore precisely the same in character as those formed by a Reiss receiver.

PERCIVAL JENNS

St. John's Rectory, British Columbia

Inherited Memory in Birds

SOME interesting communications have lately appeared in NATURE on this subject, accounting for the wonderful knowledge of routes and localities displayed by birds in their migrations, by the theory that the impressions made on the brains of the parents are transmitted to their offspring, and that which we call vaguely instinct is often inherited memory.

The following circumstance is hard to explain on any other theory:—

About twelve years ago I was residing on the coast of Co. Antrim, at the time the telegraph wires were set up along that charming road which skirts the sea for twenty-five miles between Larne and Cushendall. During the winter months large flocks of starlings always migrated over from Scotland, arriving in the early morning. The first winter after the wires were stretched along the coast I frequently found numbers of starlings lying dead or wounded on the roadside, they having evidently in their flight in the dusky morn struck against the telegraph wires, not blown against them, as these accidents often occurred when there was but little wind. I found that the peasantry had come to the conclusion that these unusual deaths were due to the flash of the telegraph messages, killing any starlings that happened to be perched on the wires when working.

Strange to say, that throughout the following and succeeding winters hardly a death occurred among the starlings on their arrival. It would thus appear that the birds were deeply impressed and understood the cause of the fatal accidents among their fellow-travellers that previous year, and hence carefully avoided the telegraph wires; not only so, but the young birds must also have acquired this knowledge and perpetuated it, a knowledge which they could not have acquired by experience or even instinct, unless the instinct was really inherited memory derived from the parents whose brains were first impressed by it.

Sudbury, Suffolk J. SINCLAIR HOLDEN

Butterfly Swarms

SOME, at least, of the swarms of *V. cardui* originate in Africa, one of which I witnessed a day's march west of Sowakin, in Nubia, in March, 1869. Our caravan had started for the coast, leaving the mountains shrouded in heavy clouds, soon after daybreak. At the foot of the high country is a stretch of wiry grass, beyond which lies the rainless desert as far as the sea. From my camel I noticed that the whole mass of the grass seemed violently agitated, although there was no wind. On dismounting I found that the motion was caused by the contortions of pupæ of *V. cardui*, which were so numerous that almost every blade of grass seemed to bear one. The effect of these wrigglings was most peculiar, as if each grass stem was shaken separately—as indeed was the case—instead of bending regularly before a breeze. I called the attention of the late J. K. Lord to the phenomenon, and we awaited the result. Presently the pupæ began to burst, and the red fluid that escaped sprinkled the ground like a rain of blood. Myriads of butterflies limp and helpless crawled about. Presently the sun shone forth, and the insects began to dry their wings; and about half-an-hour after the birth of the first, the whole swarm rose as a dense cloud and flew away eastwards towards the sea. I do not know how long the swarm was, but it was certainly more than a mile, and its breadth exceeded a quarter of a mile.

SYDNEY B. J. SKERTCHLY

Distribution of the Black Rat

FROM Prof. Giglioli's letter in NATURE, vol. xx. p. 242, it appears that the black rat is more abundant and widely distributed in Italy than in England. I know of some half-dozen specimens having been caught from time to time in the city of London, and in November, 1876, a male about six weeks old was caught, which lived in confinement for two years and three months. It was mated with a tame white one, and they had two litters of young which were black, save the feet, tip of tail, and a small brush of pure white upon the chest.

CHAS. COPPOCK

Grosvenor Road, Higbury New Park, July 11

Pine Pollen and Sulphur

BY a coincidence which depends upon the season of pollen-discharge occurring at the same period in Scotland as in England, I am enabled to send you an extract from the *Haddingtonshire Courier* of June 27, which may serve to dissipate the "sulphureous theories" of Mr. Carpenter's opponents.

"The rustics in this district [Gifford] have been of late much interested in a peculiar shower which had fallen in the early morning of Monday last. All the pools on the roads were covered and fringed with a powdery substance strongly resembling the flowers of sulphur. A calculating Good Templar found that the fiery powder had been drifted more about the houses of those who loved the flowing bowl than those who loved the

contents of the flowing river. One old woman, however, dispelled the Templar's idea by stating that she had felt the smell of 'brumstane' near her dwelling, and on searching the premises it was found the water-barrel had got a saffron cap on, and was otherwise dusted with the subtle powder. As this mystery, if it is not explained, may prove serious to the nervous, superstitious, or credulous part of the community we may as well add that at this season districts in the neighbourhood of fir plantations run the risk of a thorough dusting of this powder if there is the slightest breeze, as the cones of the young Scots fir are thickly coated with yellow powder or pollen, which will give out a blinding saffron cloud on the slightest irritation."

The laudable desire of our newspaper correspondent to relieve the anxieties of his neighbours at a time when the Presbyterian world is much exercised over the question of eternal and sulphureous punishment, can be fully appreciated only by natives. But in my opinion, the correspondent, in his clear knowledge of the nature of the "brimstone" deposit, exhibits a most praiseworthy tendency to explain the natural in terms of the natural; whilst the incident tends to show at the same time that there are not a few persons in this world to whom a course of elementary studies in natural history would serve as a means of culture, not to say of common protection against ludicrous mistakes such as those against which Mr. Carpenter inveighs. ANDREW WILSON

Edinburgh Medical School

Plague of Rats

I SEE by NATURE, vol. xx. p. 65, that Mr. Orville A. Derby contributes some very interesting information relating to a plague of rats in Brazil, and adding that the plague "is said to occur at intervals of about thirty years, and to be simultaneous with [the drying of the *Taquara*, or bamboo, which everywhere abounds in the Brazilian forests." It may be interesting to know that a similar plague of rats visited the higher coffee districts of Ceylon during the year 1875, doing great damage to young and old plantations alike.

It is remarkable that the invasion of rats was simultaneous with the flowering and death of the *Nilloo* (*Strobilanthes*), which forms the greater part of the underwood of Ceylon forests, and is said to flower and die once every seven years. The most remarkable part of the plague was that the rats did not seem to devour any part of the branches they cut off, but to nip off and leave them untouched upon the ground. So serious indeed was the damage done, that on some coffee estates rewards were given to coolies for every rat they caught, and it was not an uncommon thing to hear of three or four hundred rats being destroyed, on *one* estate only, per week.

Between the years 1840 and 1850 there was a similar plague in the Kalebokka coffee district, where the damage done was immense, but I am not aware if it was so general as in the rat plague of 1875. It is to be hoped that we may not again be invaded in 1882, when the *Nilloo* is next expected to die.

Ballangoda, Ceylon, June 16 FREDERICK LEWIS

Glow-worms

SHELLEY sings of a "glow-worm golden in a dell of dew," but last night, at 10 o'clock, while travelling on a bridle path among the bleak lonely mountains of Tynron, Dumfriesshire, bearing up against a high wind with cold rain, I espied three glow-worms shining among the grass and ferns. I had seen them in the same locality before, but scarcely expected to have noticed them in such ungenial weather when summer has with us scarcely yet begun. J. S.

July 8

Headless Butterfly laying Eggs

ABOUT three o'clock on the 11th inst. I picked up a butterfly, probably belonging to the genus *Vanessa*. It was a female, the head of which had recently been plucked off by a bird, and was lying near the body. Thinking it was dead, I carried it home to examine the wing scales. On clipping off a bit of wing about four hours afterwards, the legs moved, and in a short time an egg was laid. In about two minutes another egg was laid. Others followed, till five-and-twenty had been expelled. Tremors of the legs and wings accompanied each deposit. The laying ceased, and the headless mother seemed dead. Next morning, on touching her, the motions of the legs and wings were repeated, and in a short time the laying was resumed. On close examination a heaving of the wings and rings of the abdomen could be observed, with about the frequency of human breathing. At the end of twenty-nine and a half hours from the time of finding, the laying ceased; seventy-eight eggs were laid by the butterfly with her head off. A. STEPHEN WILSON

North Kinmundy, Aberdeen, July 14

THE COMPARATIVE ANATOMY OF MAN[1]

III.

The Mongoloid People of Asia

TO the north and east of the line already spoken of, running northwards from the head of the Bay of Bengal to the north of the Caspian Sea, the bulk of the people of the Continent of Asia belong to the Mongolian, or better, Mongoloid type.

The physical characters of these people, best seen in the so-called Tartars who inhabit the country to the north of the great wall of China, are as follows: the complexion is pale brown, usually with a yellowish tinge; hence they are spoken of as the "yellow races," in contradistinction to the (so-called) white and black races. Their hair is black, perfectly straight, and coarse. In microscopic section it is seen to be of large size, and more inclining to cylindrical than in other races, but it varies much. Except on the scalp, where the hair is often long, the capillary development is very scanty. On the face it is often limited to two slender pencils on the upper lip; and the beard, when developed, is acquired comparatively late in life. The face is broad and flat; the space between the eyes is wide; the nose small, straight, and compressed; the eyes dark and small; the aperture between the lids narrow and somewhat oblique, being raised at the outer corner; the upper lid drooping, the inner corner partly covered by a vertical crescentic fold of skin; the cheeks very prominent; the mouth and lips of moderate size, the lower lip often hanging; the chin small and sharp.

The osteological characters of the typical Mongolian are more marked in the face than in the cranium, for the latter may vary between the extremes of brachycephaly and dolichocephaly, though the former prevails. The face is large, being both high and broad; the forehead flat, the glabella and superorbital ridges slightly developed; the orbits round, with thin sharp margins, the sub-glabellar nasal depression very slight; the nasal bones narrow and flat; the whole framework of the nose inclining to the leptorhine form; the jaws of medium prominence; the arch of the mouth broad and round; the malar bones both broad and deep. Perhaps the most distinctive feature of the Mongoloid face, which gives it the characteristic appearance, is the forward position of the outer margin of the orbit, as compared with the median line of the face. In order to estimate this character with exactness, Prof. Flower measures the angle formed between two horizontal lines meeting at the most depressed point of the nasal bones in the middle line (the apex of the angle) and resting on the middle of the outer margins of the orbit. This *nasi-malar* angle gives valuable average results. For instance, the average of 130 European skulls is 131 deg., of the twenty Maravars mentioned in the last abstract, exactly the same; of 20 African negroes 134 deg., and of 20 Australians 135 deg. In all of the true Mongolian races, the average exceeds 140 deg. Thus, in 4 Samoyedes it is 144 deg.; in 16 Chinese, 142 deg.; in 7 Japanese, 141 deg.; in 4 Burmese, 144 deg.; in 26 Eskimo, 144 deg.

The Mongoloid races of Asia are conveniently divided into two groups, the northern and the southern. The former, called Mongolo-Altaic races, are united by languages having considerable affinities. They nearly all lead a nomadic life, depending for their living on hunting, fish-

[1] Abstract of Prof. Flower's Hunterian Lectures, delivered at the Royal College of Surgeons, commencing on Wednesday, March 5. Continued from p. 246.

ing, and cattle-breeding. Occasionally, when united under the leadership of some military chieftains of extraordinary capacity, as Attila, Tchinghis Khan, and Timur, they have overrun nearly the whole of the continents of Asia and Europe; now, however, they are everywhere either the actual subjects, or live by sufferance, of the people over whom they formerly terrorised—the Russians, Chinese, &c.

The anatomy of these races is only represented in the museum by a complete skeleton and several skulls of Samoyedes, a people now inhabiting the most inclement parts of North-western Siberia. They were conquered by the Russians in 1499. They are dwellers in tents made of pieces of bark covered with reindeer skins, and live chiefly by fishing and the chase, and by the produce of the herds of reindeer which they keep. Their external physical characters are always described as being typically Mongolian. Their skulls are very broad and low, the average latitudinal index of four being 847, and the average altitudinal index 719. They are, therefore, decidedly brachycephalic. The orbits are round (megaseme), the average index being 938; the nasal index is 431, so that they are truly leptorhine; the alveolar index of 102 shows them to be mesognathous, with a strong inclination to prognathism. The skeleton, that of an old male, is slightly below five feet in height. The pelvic index is only 78, but both bones of the upper extremity are disproportionately long compared with those of the lower limb, and the radius and the tibia are relatively longer compared with the proximal segments of the limbs than in Europeans.

The Turks, the Magyars, the Finns, and other representatives of the Mongolian type, have for so many generations intermingled with the people through whom they have passed in their migrations, that their original physical characters have been completely modified. Even the Lapps, a diminutive race of nomads, inhabiting the most northern parts of Europe, supposed to be of Mongolian descent, show so little of the special attributes of that race, that it is difficult to assign them a place in a classification based on physical characters. Their crania are remarkably capacious, one in the collection being as large as 1,800 c.c., and another 1,600. They are brachycephalic, have a latitudinal index (average of seven) of 812. The orbital index of the same number is 984. The nasi-malar index, though lower than in the true Mongolian, being about 136°, is higher than in the other Europeans.

Races of Eastern Asia

Many races of Asia, of similar physical type to the Mongolian, are divided from the Altaic group by language and by mode of life. One large group is formed by the people of Thibet and Burmah, with various tribes dwelling within the north-eastern frontiers of India. The four Burmese crania in the museum are all short, high, round, or rather square skulls; the average latitudinal index is 82, and the altitudinal index nearly as high. The orbital, nasal, and alveolar indices are all moderate. The nasi-malar angle of 144° is thoroughly Mongoloid. From the Burmese, the transition (physically) to the Malays is very easy; and through the Malays, the purer races of the Polynesians are connected with the inhabitants of Central Asia.

The various races constituting the population of the vast empire of China all belong to the Mongolian type, and have gradually moved southwards to their present dwelling-places.* The existing reigning dynasty is Mandschurian, belonging to the Tungus branch of the Altaics. The Chinese proper formed their earliest settlements in the north-western provinces of what is now called China about 2000 B.C. The aboriginal tribes they found there still exist, as the Miaw or Miautze, &c.

The following cranial characters of the Chinese are deduced from sixteen specimens of the male sex:—The average capacity is 1,424. The index of breadth is 782, so they fall under the mesocephalic category, inclining to brachycephaly. All the other Mongolian races hitherto treated of have been decidedly brachycephalic. The height-index is lower, viz., 753. The general form of the face is Mongolian, the forehead smooth, with little development of the glabella, the space between the orbits wide, the malar bones large and prominent, the anterior root of the jugal arch stands out laterally from the face, then turns sharply backwards beyond the maxillo-jugal suture, instead of gradually sloping backwards from that point, as in the English skull. The nasi-malar angle is 142 deg. The orbital, nasal, and alveolar indices are all medium, being respectively 869, 504, and 993.

The Japanese differ entirely from the Chinese, and resemble the Altaic races in the polysyllabic character of their language. They appear to have migrated from the Asiatic continent to the islands they now inhabit in the seventh century B.C., first taking possession of the southernmost island, Kiu-siu, and soon afterwards passing on to Niphon, gradually driving out the original population, the Ainos. It is, however, probable, that some portion of the latter became absorbed into the conquering race, which circumstance may account for part of the diversity of features and type seen among them. In the main the physical characters of the Japanese are Mongolian. At present we have really very little information about their anatomy. There are but six male skulls in the College Museum, which give the following averages:—Capacity, 1,486; latitudinal index, 771; altitudinal index, 753; orbital index, 910; nasal, 472; alveolar, 971; nasi-malar angle, 141 deg.

The people who inhabited Japan before the Japanese are called the Ainos. They have lately attracted much attention from ethnologists, owing to the fact that in their physical characters, manners, and customs, they entirely differ from all the other races of the part of the world in in which they dwell. They formerly inhabited the whole of the Japanese islands, Saghalien, and the Kuriles. They are mentioned in Chinese books before the time of Confucius, under the significant title of the villous or hairy men, and are called by the Japanese, "Mo-sins," a word having the same signification. "Aino," in their own language, means "the men," or "the people." Their numbers are now extremely reduced, and the territory they occupy limited by the encroachments of the Japanese from the south, who have driven them up to the most northern part of the island of Jesso, while the Mandschu Tartars have taken from them more than two-thirds of the Island of Saghalien. Though their language has received a considerable infusion of Japanese and Mandschu words, it appears to be of fundamentally different origin. They have no agriculture, and live principally by fishing and hunting, shooting deer and bears with the bow and arrow. They appear to be good-natured, honest, and of a mild, contented disposition.

In stature they are short (the men about 5 feet 2 inches in height), but stouter made, and more hardy and muscular, than the Japanese. Their head is large, their colour rather dark; their forehead low, the superciliary ridges prominent, the nose straight, short, and thick, and rounded at the end. The eyes are open, and not oblique like those of the Mongols, and bright, sparkling, and intensely black. What distinguishes them most in external appearance from all the surrounding races is the abundant development of their hair and beard, but this has been much exaggerated; it is black, coarse, straight, and shaggy; that on the head is worn long over the shoulders, and mingles with the beard. The few skulls known are heavy, and have the muscular impressions strongly marked. The average altitudinal index of four in Dr. Barnard Davis's collection is 78; of three measured by Prof. Flower, 74·3. These present none of the

features characteristic of Mongolian skulls, the facial bones being more European in type, and the nasi-malar angle only 129 deg. The affinities of the Ainos are at present a matter for speculation.

The Eskimo

The original inhabitants of the whole of the New World are light brown, or copper-coloured, have straight black hair, and show, amid considerable diversity in detail in particular regions, a far greater resemblance than can be found in any other portion of the world's surface of equal extent. The Eskimo, inhabiting the most northern portion of the continent, stand, in many respects, apart from the others, and are evidently quite as nearly allied to some of the Asiatic races as they are to the Americans. These people call themselves *Innuit*, which signifies nothing more than "the men," or "the people." The word *Esquimaux*, as it is rendered in French, or *Eskimo*, in the Danish method of spelling, now usually adopted in this country, was applied to them by a neighbouring tribe of Indians, and is said to mean "eaters of raw flesh." They dwell in various scattered localities near the northern coast of North America and the great adjacent islands, from Behring's Straits to Greenland, and on the north coast of Labrador. Like the Mongolo-Altaic races of Asia, they lead a nomadic life, modified somewhat by the peculiarities of the surrounding physical conditions, dwelling in tents in summer, and in houses of snow in winter. Agriculture being impossible in such a climate, their only means of subsistence is hunting and fishing. The flesh of seals, cetaceans, and reindeer forms their principal food. In the pursuit of the two former by sea they use boats, which they manage with great dexterity. They train dogs to draw their sledges, but, unlike the Laplanders, do not domesticate the reindeer. They clothe themselves comfortably in dresses of skin, and employ bows, arrows, and harpoons in the chase. In Greenland they have reached a considerable degree of civilisation, but even here, as elsewhere, their numbers seem to be diminishing.

The Eskimo are generally below the middle size; their head is large, their legs short, and their hands and feet small; their complexion is dusky or swarthy. Their hair is black, straight, and coarse, the beard and moustache generally scanty, though sometimes moderately developed. The eyes are small, black, and sparkling; the elevation of the outer end of the aperture and the vertical fold covering the inner canthus, spoken of before as characteristic of the most typical Mongolian races, have often been observed in them. The nose is usually straight and narrow, and more or less sunken between the prominent cheeks. The mouth is large and the lips rather prominent, generally kept somewhat apart. The chin is small and pointed.

The College Museum contains as many as twenty-seven adult skulls of Eskimos, twenty-four of which are in a condition to form reliable measurements. Of these seventeen appear to be those of males and seven of females.

A typical Eskimo skull always presents such marked characters that it can never be mistaken for that of any other of the groups of mankind. It is of very large size, especially in relation to the rather small stature of the people, the average capacity of 17 male crania in the collection being 1,546 c.c. or 94·3 c. inches. This is almost exactly the same as the average English (of the lowest class), but it exceeds that of 74 modern Italian males by 71 c.c., and it is above the average of Australian males by as much as 261 c.c. or 16 c. inches. The large size of the brain of all hyperborean races, Lapps as well as Eskimo, seems not necessarily to be connected with intellectual development, but may have some other explanation not at present quite apparent. The next distinctive character of the Eskimo skull is its great length and narrowness, especially in the upper part. The base is fairly broad, and the mastoid processes are well developed; but, instead of expanding upwards to the parietal region, it narrows, and, towards the median line above, contracts so rapidly that the upper part of the skull has the form of the roof of a house. Measurements of various series of Eskimo skulls give remarkably uniform results as regards the latitudinal index, the average being from 71·2 to 71·4, so that it may be considered as perfectly established, that the Eskimo are among the most dolichocephalic of races. The female skulls are somewhat broader than the male. The index of height is somewhat greater than that of breadth, averaging 73·5. The cranial sutures are very simple; and among the specimens examined there is no case of metopism or persistence of the frontal suture, nor is there any case of the squamosal bone meeting the frontal at the pterion.

The whole face is large, both high and broad; the forehead is flat, the glabella little developed; the orbits are round, and the malar bones of great size and very prominent, giving a nasi-malar angle of 144 deg. The nasal bones are small and narrow, often coming to a point at their upper ends, and the whole aperture is very long and narrow. The Eskimo are, in fact, the most leptorhine of all races; the average nasal index of the 17 male skulls before spoken of, being only 42·2, the average of European crania being about 47, and that of Australians 56. The projection of the jaw is moderate, giving an alveolar index of 100·8, which brings them into the mesognathous category, with an inclination towards prognathism. The arch formed by the series of teeth is remarkably short, broad, and round. The teeth are small, and generally become worn down to stumps as life advances.

Two out of the three Eskimo skeletons in the Museum possess one more than the usual number of vertebræ, the additional one being interposed between the dorsal and lumbar series, and partaking of the character of both. The brim of the pelvis is remarkably wide transversely, and thus, as also in the limbs, they deviate widely from the negro type: for example, the humero-radial index, which in the Andamanese is as high as 82, in Negroes 79, in Australians 77, and in Europeans 74, does not exceed 71·3 in either of the three skeletons, the average being 71·1.

Dr. Barnard Davis has shown that the special peculiarities of the Eskimo skull are most marked in Greenland; there is also good evidence that the Eskimo have migrated from the west towards the east, and did not reach Greenland, at all events in its southern parts, until the fourteenth century. Their affinities, moreover, as shown by physical characters, are more with the inhabitants of North-Eastern Asia than with the American Indians, and it is not at all improbable that they are derived from the same stock as the Japanese. In this case the peculiarities by which the Eskimo are differentiated from the Asiatic Mongolians cannot have been developed by crossing with other nations, on account of their complete isolation, but must be attributed to those gradual modifications, produced by causes at present little understood, by which most of the striking variations we have met with in the human species have been brought about; modifications more strongly expressed the more completely isolated the race has become, and the further removed from its original centre of distribution.

OUR ASTRONOMICAL COLUMN

THE DUNSINK OBSERVATORY, DUBLIN.—The third part of "Astronomical Observations and Researches made at Dunsink, the Observatory of Trinity College, Dublin," has been published by Dr. Ball. It contains four papers, the first by the previous director, Dr. Brunnow, presenting a discussion of observations of the

planetary nebula H. IV. 37, the position of which is in R.A. 17h. 58m. 36s., N.P.D. 23° 21′·8 for 1880. The nebula appears in the South-refractor as a somewhat elliptical disk, whose major axis is about half a minute, and has in the centre a well-defined point resembling a star of the eleventh magnitude. This point was compared in declination with a star to the north of the tenth magnitude, preceding the nebula by 25s., the same method of observing being used that had been adopted in Dr. Brunnow's earlier researches on stellar parallax. The observations extend over thirty-three nights, from 1871, August 13, to 1872, August 6, and their discussion gives for the parallax of the nebula, + 0″·047 ± 0″·030. Prof. Bredichin, in "Annales de l'Observatoire de Moscou," vol. iii., has found a negative parallax (− 0″·064 ± 0″·039), using also the method of differences of declination with the same star of comparison. The results of these investigations may be taken to indicate that the parallax of this planetary nebula if measurable at all must be very small. The second paper contains Dr. Ball's observations of 61 Cygni, and his determination of its parallax therefrom. By what was at first an inadvertence, instead of using the following of the two components as Dr. Brunnow had done, the preceding one was observed, and the mistake not being remarked until the series was considerably advanced, it was resolved to complete it as begun; perhaps the result possesses for this reason additional interest. Dr. Ball finds for the parallax + 0″·4654 ± 0″·0497, which is about a mean of the values obtained by Bessel, Johnson, Peters, Struve, and Auwers, which appear entitled to the greatest weight. The observations extending from 1877, July 3, to 1878, June 1, are given in their original form. The third paper, also by Dr. Ball, relates to "observations in search of stars with a large annual parallax," forty-two stars being examined for this purpose, including several red and variable stars: the results, however, are found to be entirely negative as regards the object in view, no amount of parallax worth following up being suggested. The principle upon which the observations were made is fully described and their details appended to the memoir. The last portion of the Dunsink publication contains Dr. Brunnow's measures of double-stars 1870–73.

THE SOLAR ECLIPSE OF JULY 19.—The Observatory of Paris is situate very close upon the northern line of simple contact in this eclipse, which will add interest to observations that may be made there. The *Connaissance des Temps* employing the lunar tables of Hansen and the solar tables of Leverrier, gives the magnitude of the eclipse only 0·013 (the sun's diameter being taken as unity), commencement at 7h. 46·1m. A.M. mean time at Paris, ending at 8h. 5·4m. At Gibraltar the magnitude of the eclipse will be 0·32 at 7h. 9m. local mean time, and at Malta 0·38 at 8h. 46m. As we have before remarked the only civilised station where a great eclipse is likely to be witnessed is Aden. The eclipse is strictly an annular one, but the moon's augmented semi-diameter is only five seconds less than the sun's semi-diameter, where the greatest phase occurs near apparent noon. At Aden at oh. 12m. P.M. 97-100ths of the sun's diameter will be covered by the moon; the line of annular eclipse falls upon the opposite African coast.

PERIODICAL COMETS IN 1880.—Two known comets of short period will be observable before the end of the ensuing year, viz., Winnecke's, which may be in perihelion early in December, and Faye's, which, according to Dr. Axel-Möller, again arrives at its least distance from the sun in January, 1881. The perturbations of Winnecke's comet during the actual revolution will not be important, and from Prof. Oppolzer's elements of 1875 it seems likely that difficulty may be experienced in securing observations, the track in the heavens if we assume the time of perihelion passage to be December 1·5 being as follows:—

1880-1.	Right Ascension.	Declination.	Dist. from earth.
	° ′	° ′	
Oct. 2 ...	196 29	− 0 15	2·223
Nov. 1 ...	224 3	− 11 35	1·944
Dec. 11 ...	276 17	− 23 21	1·753
21 ...	290 43	− 23 40	1·767
31 ...	304 31	− 22 43	1·808
Jan. 10 ...	317 14	− 20 46	1·876
30 ...	338 44	− 15 13	2·072

METEOROLOGICAL NOTES

THE Eleventh Contribution to Meteorology by Prof. Loomis appears in the *American Journal of Science and Arts* for this month. With the view of inquiring whether areas of low atmospheric pressure sometimes result from a circulation of the surface winds not extending to a height of 6,000 feet, Prof. Loomis has examined eighty-nine storms and compared in each case the average direction and force of the surface winds near the base of Mount Washington with the winds at the top of the mountain. In the majority of those cases in which a storm with its area of low barometer passes over the New England States, the usual system of circulating winds which prevails at the surface, does not extend to the height of 6,000 feet. In cases, however, when the depression is unusually great, this system of circulating winds extends to that height. When the system of circulating winds reaches to the top of Mount Washington, the change of wind into the east usually begins near the base eleven hours sooner than on the top of the mountain; and the change subsequently into the west usually begins at the base five hours sooner than on the top.

IN the same paper Prof. Loomis examines eight storms, the average courses of which were approximately from south to north, and six storms which travelled from north to south, with the view of obtaining information from such abnormal storm paths, regarding the causes which determine the movement of storms with their low barometers from place to place. These two groups of storms present characteristics very different from each other. As contrasted with the other group, storms moving to northward show a central pressure, becoming more depressed as they advance; the southerly winds accompanying them are marked by a greater humidity and velocity; and the rainfall is very greatly in excess. If attention be exclusively directed to storms moving to northward the facts seem to favour the idea that in a great storm the condensation of vapour is an efficient cause which controls the movement of the winds. Storms moving to southward, however, show very different results, areas of low pressure being observed to be formed with little rain and sometimes even with none at all. The general conclusion the inquiry seems to point to is that the initial depression of the barometer is the result of a system of circulating winds, the most frequent cause of which is two or more areas of high pressure at considerable distances, often 1,400 miles from each other, differences of temperature and humidity being important agents in producing, but more especially in maintaining, such a system of winds. If this be so, then the points in the inquiry calling for the most serious attention are the causes which conspire in bringing about those wide areas of high pressure round a region of lower though still high pressure and the concentration of moister and warmer air over this region.

THE *Results of the Meteorological and Magnetic Observations for* 1878 made at Stonyhurst College have just appeared. To the routine work of the observatory has been added the preparation of an agricultural report sent weekly to the Meteorological Office; and to the usual observations are added observations of crops, flowers, shrubs, and trees, and a complete and very valuable table

of the directions in which the upper clouds (cirri) were observed to move during the year with the dates, and the direction and force of the surface winds at the same times. The meteorological observations made at Kerguelen Island during the Transit of Venus Expedition have been discussed, together with those made on board the *Challenger* and the *Erebus* and *Terror;* and the three series of results have been handed over to the Meteorological Office for publication. Their appearance will be looked forward to with the greatest interest on account of the well-marked and extraordinary differences between the daily fluctuations at Kerguelen Island and those in similar latitudes of the northern hemisphere. An extremely interesting table is given showing the monthly rainfall for the thirty years ending 1877. The results show a maximum in October and a minimum in April and May, which agree with the same phases of the rainfall over similarly situated places in this part of Great Britain. The curves of amount and frequency of rainfall show an increase during the past twenty years. They show also a minimum about 1855, and, though not a minimum, yet a distinctly marked depression about 1866, the next minimum sun-spot.

FROM the "Results of the Rain Observations made in New South Wales during 1878," just published under the superintendence of Mr. Russell, Government Astronomer, we learn with extreme satisfaction that this important element of climate is now being observed at ninety-six stations, fairly well distributed over the Colony. A large map accompanies the report, showing the positions of the rain-stations by black circles, the size of which are proportional to the amount of the rainfall for the year, the largest being Fort Macquarie, on the coast, representing 62·50 inches, and the smallest Lake Boulka, 5·61 inches. Setting aside a few local deviations, due to physical configuration, and probably in one or two cases to the shortness of the period (one year), the amounts show, as was to have been looked for, a gradual diminution from the coast inland. The manner and amount of this diminution over the different districts the observations of future years will disclose. The results of this system of observation, taken in connection with the systems of Queensland, South Australia, West Australia, and Victoria, will in a few years go far to solve the important practical problem of the distribution of the rainfall over Australia. An interesting table is given of the mean height above summer level of the Murray River at Echuca, thirty miles south of Deniliquin, from 1863 to 1878. The annual amounts show decided minima about 1866 and 1877, separated by a maximum about 1871; and the monthly amounts a great excess from July to December, when the mean height above summer level is 17½ feet, as compared with 5⅛ feet of mean height during the other six months. The annual maximum floods varied from 18½ feet in 1855 and 1877 to 38 feet in 1870, and the average date of their occurrence is early in October.

GEOGRAPHICAL NOTES

IN its issue for July the *Financial and Mercantile Gazette* of Lisbon publishes a map of a portion of Africa, for which it is indebted to the courtesy of Major Serpa Pinto, and on which that explorer's course through the Dark Continent is laid down. The map is rendered the more interesting by the fact that it also shows the routes followed by Livingstone, Cameron, and Stanley. Last night, as we intimated last week, Lord Northbrook, as President of the Geographical Society, gave a reception in Major Pinto's honour, at which a large number of eminent geographers and others were present.

THE Tlemcen *Courrier* (Algeria) describes a large subterranean lake recently discovered at the Cascades of Tlemcen. The opening seems to have been brought to light by some workmen who blasted a large rock at the Cascades. Entering in a rude boat the cave thus exposed they sailed for about three kilometres by the aid of torches, which revealed magnificent stalagmitic columns joining the roof and the bed of the lake. The other end of the lake seems to give off a stream at Sebdou supposed to form the source of the Tafna. The account given by the *Courrier* is rather vague. It states the lake abounds with blind fish, many of which were caught.

THE first number has reached us of a new monthly periodical, entitled *L'Afrique explorée et civilisée* (Geneva: Sandoz), to the prospectus of which we referred recently. It does not contain much new information, except, perhaps, as regards the Belgian Congo flotilla, the proceedings of which we shall watch with great interest. With the endless misfortunes of the International Association's land expedition in Eastern Africa before our eyes, we fear that great things must not be expected, unless, indeed, Mr. Stanley be eventually placed in supreme command. The number contains a map of the continent, which has been specially prepared by Lieut.-Col. Adan, the head of the military cartographical establishment at Brussels, and on which are shown the routes of recent explorers of Africa.

THE *Colonies and India* furnishes some interesting information in regard to the geographical aspects of the scheme for constructing a railway across the Sahara from Algeria to Timbuktu. An expedition is to start in September to make a careful survey of the route, and in order that it may be supplied beforehand with the best information procurable, prizes to the value of 200*l.* are offered for the best papers descriptive of the country between Golaeh and Timbuktu. Opinions appear to be conflicting as to the practicability of the scheme. M. Soleillet, whose recent journey in West Africa we have before alluded to, thinks unfavourably of it; but MM. Foureau and Fau, who have lately explored a large part of the country south of Algeria, aver that the so-called desert is hardly a desert at all.

UNDER the title of "Le Laos et les Populations sauvages de l'Indo-Chine," the *Tour du Monde* has just commenced the publication of an account by Dr. Harmand of his travels in the interior of the Indo-Chinese peninsula in 1877. The narrative is illustrated by well-executed and interesting engravings from sketches and other material furnished by the author.

THE leading paper in the June number of the *Bulletin* of the Paris Geographical Society is an Introduction to the Monuments of Geography by the late M. Jomard, edited by M. E. Cortambert; the present instalment is mainly a history of the progress in the art of map construction. M. Opegez describes a journey made by himself and some companions from Buenos Ayres to Jackal at the foot of the Andes, and Prof. Paul Chaix contributes interesting notes on Siam, an Egyptian Calendar, and the First Meridian; he does not see any inconvenience in the present variety of first meridians. We are glad to see that the *Bulletin* is getting more and more prompt in publication.

IN No. 81 of the *Zeitschrift* of the Berlin Geographical Society Herr K. Himly treats at considerable length of two Chinese cartographical works, and Herr Beuster, a German missionary, gives the result of his observations on the Vainenda, an African people settled in the north-east of the Transvaal "Republic," as he still calls this British possession. The *Verhandlungen* of the same Society, No. 6, contains a paper by Dr. Junker on his three years' travels in Central Africa; while Dr. Kiepert briefly describes some recent explorations to the north-east of the Caspian Sea, hitherto but imperfectly known.

PROF. MOEBIUS ON THE EOZÖON QUESTION

THE eminent zoologist, Dr. Karl Moebius, of Kiel, has recently published a treatise, "Der Bau des *Eozöon canadense* nach eigenen Untersuchungen verglichen mit der Bau der Foraminiferen" ("The Structure of *Eozöon canadense*, according to my own Investigations, compared with the Structure of Foraminifera"), which first appeared in the "Palæontographica" (vol. xxv.), and was afterwards republished separately. Prof. Moebius inclines entirely towards the view of King and Rowney

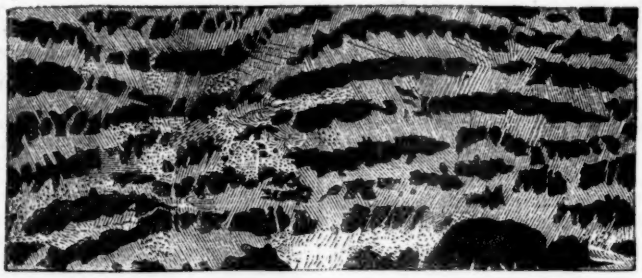

FIG. 1.

(*Proc. Roy. Irish Acad.*, ser. 1, x. and ser. 2, i.) disputing the organic character of Eozöon. The question is one of such great interest, and the paper is so sure to originate controversy, that we have no doubt the following abstract of the chief points in Dr. Moebius's treatise will be welcomed by our readers.

After a concise account of the history of the Eozöon question, since the remarkable discovery by Prof. Dawson and the detailed investigations made by Prof. Carpenter, Dr. Moebius commences the discussion of the subject by stating that he was first led to the study of Eozöon through observation of the structure of a

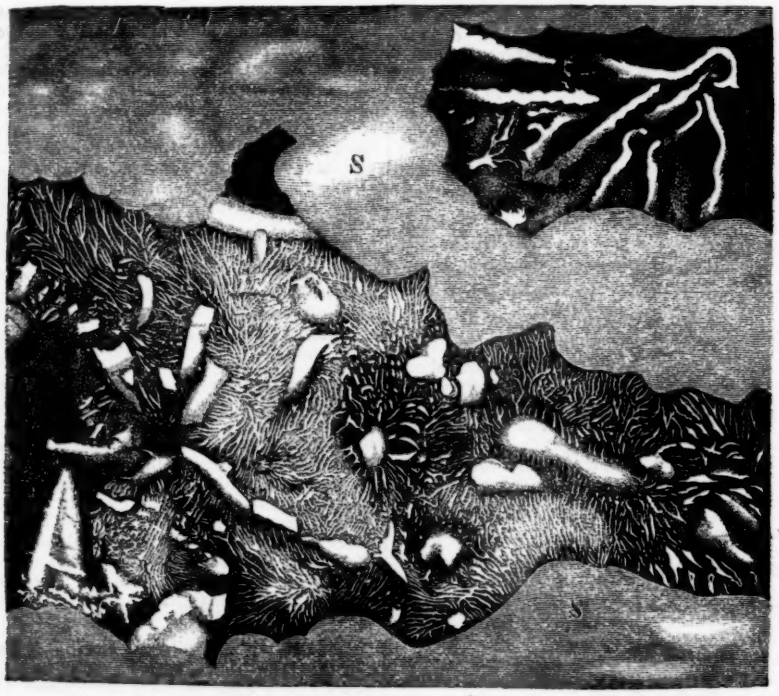

FIG. 2.

rhizopod, found by him in 1874 on the coral reefs near Mauritius, and to which he had given the name of *Carpenteria rhaphidodendron*. This consists of tree-shaped individuals which often form turf-like growths of several centimetres in length, breadth, and height. Sections of such growths surprised Dr. Moebius by their great likeness to the representations of Eozöon sections accompanying the descriptions published by Dawson, Gümbel, Fritsch, &c. He therefore resolved to make a careful investigation of Eozöon and to compare it with *Carpenteria rhaphidodendron* and other foraminifera, in order to form his own judgment regarding its nature, and to

establish such reasons and facts as might lead to a generally acceptable and final decision of the Eozöon question.

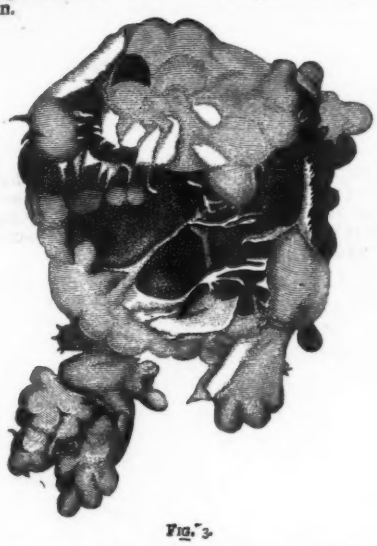

Fig. 3.

With this object in view Dr. Moebius investigated upwards of ninety Eozöon sections, of which many were placed at his disposal through the kindness of Dr. Carpenter, and of which many others originally belonged to Prof. Dawson; there was no doubt, therefore, that the sections possessed those properties which had led the latter to declare the formation to be of animal origin. According to Dr. Moebius *Eozöon canadense* consists principally of alternate layers of yellowish green serpentine and whitish limestone. Fig. 1 is the representation of a good Eozöon section, magnified four times.

The darker parts represent the serpentine, the lighter ones the limestone which in many places completely surrounds little rounded nodules of serpentine. Both the limestone layers, as well as the serpentine layers, have indentures and frequently end in wedge-shaped points. They generally attain a thickness of two or three millimetres. In the limestone, even when magnified only four times, the straight and parallel division lines of the thin layers of which it is composed are easily seen. Besides these division lines groups of little dots or of curved lines are noticed, representing stems and thin plates imbedded in it. These stem- and plate-shaped formations, which are of great importance with regard to the introduction of Eozöon amongst foraminifera, will be better recognised in Fig. 2.

This represents a small part of an Eozöon section, from which the limestone has been dissolved by hydrochloric acid, magnified forty times, under reflected light. The acid has only left the serpentine and the stems and plates, which, like serpentine, consist principally of silica

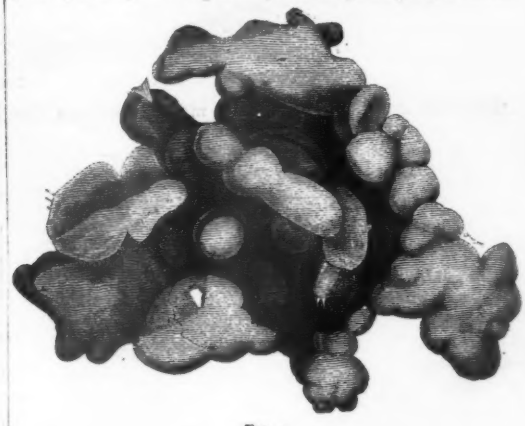

Fig. 4.

and magnesia. Between the indented bands of serpentine (S S) we see cavities which were formerly filled up by carbonate of lime. From the bottom of these cavities, which also consists of serpentine, stems and plates of

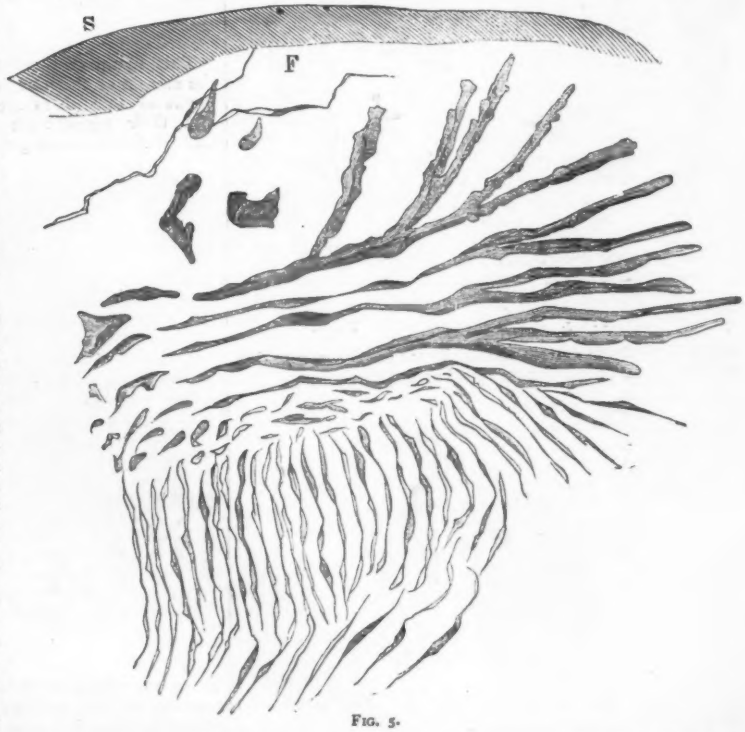

Fig. 5.

different shape and size rise in different directions. Many parts of the Eozöon contain a much smaller number

of stems than are shown in Fig. 2, such as the piece represented in Fig. 3, where the lime is also removed, and which is also magnified forty times. Still poorer in stems is Fig. 4, where only a few nodules of serpentine are provided with stems. Figs. 3 and 4 may at the same time serve to illustrate certain round shapes in the serpentine of Eozöon and their almost spiral arrangement.

FIG. 6.

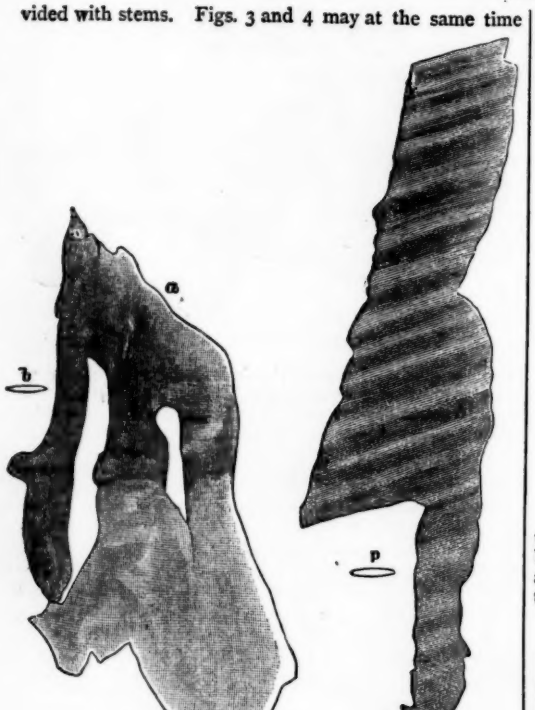

FIG. 7. FIG. 8.

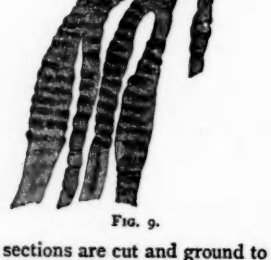

FIG. 9.

If Eozöon sections are cut and ground to such thinness that they become translucent, then they may be examined by yet more powerful microscopes and under transmitted instead of reflected light. Most of the stems then appear distinctly as simple or ramified, bent plates, giving generally concavo-convex, much less frequently bi-convex or oval cross-sections, as illustrated by Fig. 5.

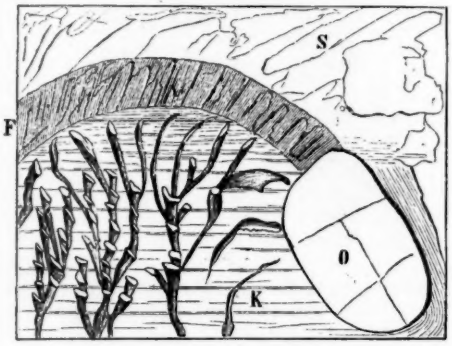

FIG. 10.

This figure represents stems magnified 150 times. A the margin of the lime in which the stems are imbedded bands of fine fibres are seen; we shall refer to these and their significance with regard to the introduction of Eozöon amongst foraminifera. Perfect certainty as to the shape of stems and plates was arrived at by treating the thin sections containing such inclosures with dilute hydrochloric acid until the stems were laid completely bare. Thus they could be separately and closely examined in a drop of water under the microscope, and a clear and exact notion of their shape could be obtained.

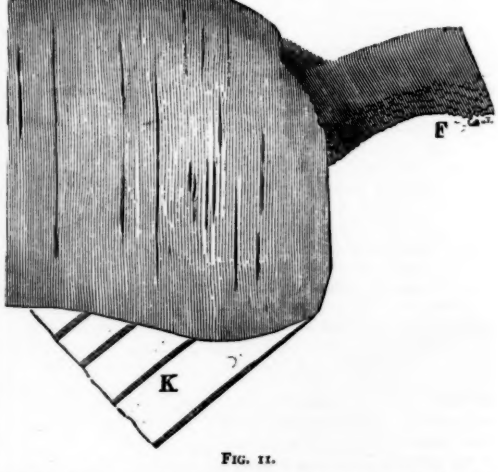

FIG. 11.

Figs. 6 to 9 represent several stems and plates isolated in the manner described and magnified 350 times.

Fig. 6 shows a bent and half tube-shaped stem; Fig. 7 a plate with two apertures; Fig. 8 a plate with alternate and parallel thicker and thinner parts; Fig. 9 a ramified stem of similar structure. In Fig. 6 the shape of the cross-section is indicated. The alternately thinner and thicker parts in Figs. 8 and 9 correspond to the lamellæ of the lime in which they laid imbedded, and therefore probably have their origin from these.

Now we have only to consider the fibres, which in many parts of the Eozöon, at the borders of the calcareous parts carrying the stems, surround the serpentine-like bands, but which in other parts pass right through the serpentine. In Fig. 5 these fibres are marked F, while the serpentine is designated by S. A very well-defined band of fibres is seen in Fig. 10 (magnified 200 times), between the serpentine S and a piece of lime in which obliquely ascending stems are cut right across at the surface of the section. O is a crystal of olivine in course of decomposition, and therefore no longer possessing sharp edges.

The fibres are imperfectly developed micro-crystals of chrysotile, which like olivine and serpentine consists of silica and magnesia. In many fibre-bands, with the application of strong magnifying powers, it is observed that the fibres are very small four-sided prisms. In Fig. 11, near F, such fibres are shown, magnified 500 times; to the left are long, less distinct, needle-shaped chrysotile crystals, besides lime (K).

(*To be continued.*)

NOTES

We have received from the U.S. Signal Office the monthly *Bulletins* for November and December, 1874, January, 1875, and January, February, and March, 1877. We hope shortly to begin, through the courtesy of General Myer, the regular publication of a map exhibiting the simultaneous monthly means in meteorology of the whole of the Northern Hemisphere. The immense value of such a publication to meteorological science we need not point out, and the enterprise of the U.S. Signal Office in working out and making public these data is beyond praise.

The Astronomical Museum established by Admiral Mouchez in the Paris Observatory may be considered as now complete. Besides the pictures of the principal celestial objects and portraits of the directors of the Paris Observatory, the hall contains a number of objects connected with astrology as well as astronomy, and a number of historical instruments, as the bar which was used for measuring the Peruvian degree, the similar instrument which was taken to Lapland by the Northern Commission; the pendulum used by Duperrey, and that used by Fraissinet for measuring the intensity of gravitaty in remote lands, the former being constructed by Fresnel; the bi-refracting prism used by Arago for his great optical discoveries, the portable meridian circle designed by Admiral Mouchez, &c., &c.

A solution of a problem which has lately acquired some celebrity, viz., *How to colour a map with four colours without colouring adjacent districts the same colour*, has just been obtained by Mr. A. B. Kempe, and will shortly appear at length in the *American Journal of Mathematics*. The fact that a map could be so coloured was stated by Prof. De Morgan to be well-known to map-makers, but no proof of the fact or means of solving the problem have hitherto, it is believed, been given. Some notion of the difficulty involved may be gathered from the fact that a very slight alteration in a map may render it necessary to recolour it throughout. Mr. Kempe's solution may be roughly described as follows:—He points out that every map must have a district in it with less than six surrounding it. This district he gets rid of by putting a patch over it which just projects over its boundaries, all boundaries which meet the patch being produced to meet in a point on the patch. A new map is thus obtained having one district less. This map must also have a district with less than six surrounding it which can be patched out in the same way. Continuing this process the map can at last be reduced to a blank sheet composed of overlapping patches. This can be coloured with a single colour. Stripping off the patches in the reverse order and colouring the districts as they are exposed, Mr. Kempe shows that whenever the 1, 2, 3, 4, or 5 districts surrounding a newly exposed one absorb all four colours, the colours can be rearranged in the map so as to reduce the surrounding colours to three, thus leaving a fourth for the exposed district. Thus successively taking off patches, rearranging the colours in the map, if necessary, and colouring the exposed districts, the whole map can be coloured. Mr. Kempe also shows *inter alia* that while the theorem is true in the case of globular surfaces as well as in that of maps, it does not hold in the case of such a surface as an anchor-ring.

We have received a copy of the second part of Mr. W. B. Hemsley's "Diagnoses Plantarum Novarum Mexicanarum et Centrali-Americanarum." We believe that the whole of the MSS. of the *Polypetalæ* of the botany of Messrs. Godman and Salvin's "Biologia Centrali-Americana," is now in the hands of the printer, and Mr. Hemsley is far advanced with the *Gamopetalæ*. The first part of the Polypetalæ will shortly appear. The publication of the Polypetalæ has been delayed, in order to include a very valuable collection made last year in the State of San Luis Potosi, Mexico, by Drs. Parry and Palmer.

A series of interesting experiments with the electric light commenced, by order of the authorities, at the School of Military Engineering, Chatham, on Thursday last. The experiments are for testing the relative qualities of the several inventions now in use in the Army and Navy, including Messrs. Wylde's invention (which has been fitted on board nearly all the larger ironclads in the Navy), Messrs. Siemens' invention, the Gramme light, and others. The experiments, it is expected, will last several weeks, and they will be carried out under the direction of Capt. Armstrong, R.E., instructor in telegraphy at the School of Military Engineering.

The Council of the Institution of Civil Engineers have recently made their annual awards, out of special funds bequeathed for the purpose, for approved original communications read and discussed at the weekly meetings during the past session, or printed in the "Minutes of Proceedings" without being read, as well as for papers submitted by students. From the Telford Fund medals and premiums have been bestowed on Messrs. G. F. Deacon, J. B. Mackenzie, J. N. Douglass, A. F. Blandy, E. Dobson, J. Price, J. E. Williams, G. W. Sutcliffe, E. Sang, W. G. Laws, and G. Higgin. The Manby Premium has fallen to Mr. J. P. Griffith. Miller Prizes have been adjudged to the following students:—Messrs. A. C. Hurtzig, R. H. Read, J. C. Mackay, and P. W. Britton.

The fourth marine excursion of the Birmingham Natural History and Microscopical Society to Falmouth, which extended from July 5 to 14, has proved a great success, and quite equalled, if not surpassed, the preceding ones to Teignmouth and the Island of Arran. A larger number of members than usual joined the party, which consisted of nine ladies and twenty-two gentlemen—a total of thirty-one. As hitherto the excursion was arranged so as to give facilities for the study of the marine zoology, botany, and geology of the district. For the former of these an admirable little steam tug, the *Albert*, was engaged. Land excursions were also arranged daily to interesting points, including the Land's End, the Lizard, &c. For the first time

the members had an opportunity of getting out into deep water of from forty to fifty fathoms, and a most interesting and valuable series of specimens was taken in all classes from diatoms up to fishes. The most noteworthy capture by the dredge in water of fifty fathoms off the Bay, was a specimen of the rare Alcyonarian zoophyte, *Virgularia mirabilis*. In the evenings the specimens taken were exhibited in the ladies' drawing room, some under the microscopes, under the superintendence of Mr. Marshall and Mr. Bolton. The botanists have not been idle, and nearly 400 species of flowering plants have been gathered, besides ferns of many species and varieties. A noteworthy circumstance connected with this excursion has been the kind assistance rendered by local naturalists, among whom are Mr. Howard Fox, the Rev. W. Rogers, Mr. Thomas Cornish, Mr. Tressidder, &c. Some valuable suggestions and encouraging remarks were also made in letters from eminent naturalists in special branches, viz., Prof. Allmann, Dr. Gwyn Jeffreys, Mr. P. H. Gosse, and Mr. H. J. Carter. On Thursday Mr. Saville Kent joined the party, accompanied the dredgings, and kindly rendered very valuable help. Full reports of the excursion will be presented to the Society in due course from the members who are going over the specimens; in marine zoology by Mr. Graham, the President, Mr. Saville-Kent, Mr. Wills, Mr. Trye, and Mr. Hughes; in botany by Mr. Baxenall, and Mr. Morley; and in geology by Mr. Burman and Mr. Cotterell. Every effort was made for the comfort of the visitors by the obliging manager of the Falmouth Hotel, where the party took up their quarters, and the hon. sec., Mr. Morley, was indefatigable in his efforts to make the excursion successful. Not the least enjoyable part of the excursion was the really beautiful weather, which was fine and bracing during nearly the whole period. The twentieth annual Report of this Society speaks favourably of its progress, and the more active part taken by the members in its proceedings. Some consideration has been given to plans for utilising the energy of the Society in developing original research and knowledge of natural histology. Circumstances have interfered to prevent immediate action, but we hope that before long the Society will be able to carry its plan into execution.

AT the anniversary meeting of the Sanitary Institute of Great Britain the annual address was delivered by Mr. G. J. Symons, F.R.S., on "Water Economy." Mr. Symons, in the first part of his address, explained the circumstances which combined to render the small areas in the kingdom on which upwards of 75 inches of rain fell annually, of great national importance. Almost all these districts of heavy rain were districts of hard rocks, of steep slopes, and of sparse population. The first of these conditions insured the permanency of the physical geography of the district—the rocks being too hard to be washed away—and therefore the permanency of the rainfall; the second lessened evaporation, and sent the water rapidly into the streams or lakes; and the third tended to insure the purity of the effluent water. Having traced the water from the clouds to the earth, he next considered the effect of soil, crops, inclination of ground, &c., upon the water thus precipitated. He showed the necessity for modifying our customs and laws respecting rivers and watercourses, &c., in conformity with the advance of civilisation and the increasing population of the country. He recommended that the entire administration of streams should be under a single direction, which should see to all questions of drainage, sewerage, canalisation, motive power, and water supply. Such new works as were required promptly should only be authorised subject to their reverting to Government in fifty or a hundred years. All other hydraulic works should be undertaken, or at all events supervised, by a Government department, so as to insure the greatest possible public benefit and not merely that of an individual town.

MR. R. ANDERSON, F.C.S., whose paper on Lightning Conductors and Accidents from Lightning attracted considerable attention at the last meeting of the British Association, has for some time been engaged on a large work treating the subject from a scientific, practical, and historical point of view. The book is now nearly ready, and will be published in a few weeks.

WE have received from Mr. William George of Park Street, Bristol, the first four numbers of an interesting catalogue of works referring, *inter alia*, to geography, geology, chemistry, and other branches of science. The catalogue displays a considerable knowledge of the bibliography of these subjects, and would, no doubt, interest many of our readers.

AMONG Mr. Murray's announcements are: "The River of Golden Sand; a Narrative of a Journey through China to Burmah," by Capt. Wm. Gill, R.E.; "A Lady's Life in the Rocky Mountains," and "Japanese Letters," by Miss Isabella Bird; "A Sketch of the Life of Erasmus Darwin," by Dr. Krauss, translated from the German, with a preliminary notice, by Charles Darwin, F.R.S.; "Metallurgy, Part V., Silver and Part of Gold," by Dr. J. Percy, F.R.S.

THOSE of our readers interested in India may be glad to know that Mr. Quaritch has on sale the second edition of Balfour's monumental Cyclopædia of India.

M. W. DE FONVIELLE writes:—"On July 9 I made an ascent at Douay in a small balloon, at 5·30 P.M., with a strong west-south-west wind; velocity, 1 kilometre per minute. The temperature varied from 12° to 14° C. according to the exposure, and the altitude from 900 to 1,300 metres. From 800 to 1,000 were small floating clouds of irregular shape, not more than 100 metres in altitude and 200 metres in transverse dimension, but very dense, obviously formed with pure water, without any snowy matter. We observed at six different times the white rainbow, or Ulloa Circle, at the superior surface of this cloud. This dispels the notion, published in so many text-books, that it is seen only on icicles. There were three circles—interior blue, medium yellow, and exterior red. I had not a sextant for measuring the diameter, which I suppose was not more than 25 to 30 degrees for the exterior circle, somewhat less than the little halo, and in all cases about the same, irrespective of the distance of clouds. It was, of course, seen opposite the sun. The interior part was quite silvery white, being merely reflected light from the sun. The shadow of the car, travellers, and balloon was seen in the centre with angular dimensions varying according to the distance of the clouds. The shadow was sometimes projected outside the luminous circles, being too large to be included. Once we saw distinctly a luminous circle developing round the balloon, and we had two coloured images at once. The balloon phenomenon did not last long enough to be carefully observed; it appeared less distinct. I recollect only the reddish part of it, but we are both certain of its appearance. I suggest the acceptance of the explanation given by Bravais of the white rainbow, that it is produced by the reflection of the sun's rays on the surface of small vapoury vesicles, composed of a little quantity of air imprisoned by a shell of water. I noted also a curious optical illusion of a kind which was indicated to me by Mr. Coxwell a few years ago. When the clouds were at some distance they appeared almost at the same level, and I was under the impression that the balloon was ascending as they were passing under the car at some distance below. But the barometer and other circumstances proved we were keeping almost a perfect vertical equilibrium, and travelling in a horizontal direction."

W. B. F., writing from Point-of-Air, North Wales, on the 14th inst., states that an earthquake was observed there that morning at 1.5 A.M. The direction of the undulation appeared to be from a little to the east of south to a little to the west of

north. The movement of the earth was plainly felt by several persons in the neighbourhood. Previous to the shock the night was clear, warm, and calm, with a slight air from the south-west; twenty minutes after the shock there was a thunderstorm, accompanied by very heavy rain.

FROM a statement in the House of Commons by the Under-Secretary of State, it seems that the distribution of the Indian Museum collections has not yet been determined on, and is the subject of investigation by a committee in communication with the authorities at the British Museum, South Kensington, and Kew Gardens. The main object which is expected to be gained by this step is the increased utility of the collections to the public. The Economic Section, for instance, it was stated, could be maintained and perfected with great public advantage in the experienced hands of Sir Joseph Hooker at Kew, where he already has a far better collection of similar objects; while as regards the zoological, ethnological, and art collections, their transfer to departments where they will be more generally seen and appreciated, seems better than to retain them in a museum which, somehow or other, does not attract visitors. The fact that 9,000*l.* a year will be saved to the Indian revenues, may not have been without weight in deciding to break up the Museum.

THE *Daily News* New York correspondent telegraphs as follows:—"Mr. Edison has partially overcome the obstacle to his electric light offered by the high price of platinum. His lamps, instead of costing several dollars apiece, as at first, can now be made of an alloy of platinum with inferior metals, so as to cost only fifty-six cents. He announces that he can now produce the spiral coil for incandescence at a price which all who use gas can easily afford, and that his efforts to find platinum are only induced by the desire to reduce the cost of burners still further."

NO. 27 of the *Journal* of the Society of Telegraph Engineers contains an important paper, by Col. Bolton: "Some Historical Notes on the Electric Light," consisting of abstracts from all the English patents on dynamo- and magneto-electric machines and on electric lights, classified and arranged in subdivisions according to the special class feature of each form of machine or lamp. From these abstracts it will be seen that several of the so-called new inventions on this subject that have been attracting so much attention of late are really inventions of long ago.

IN recent researches (described to the Vienna Academy) on the specific viscosity of liquids and its relation to chemical constitution, Herr Pribram and Herr Handl have observed (1) that the substitution of Cl, Br, I, and NO_2 for H in a molecule, caused, in all cases examined, an increase in the time of flow (through a capillary tube); (2) that this increase was least on substitution of Cl, and more, successively, in those of Br, I, and NO_2; (3) that for the absolute value of increase of the time of flow, not only the quality of the element introduced, but also its position in the molecule, is a determinant.

ACCORDING to Prof. Du Bois Reymond, grave sounds should be more weakened by telephonic transmission than acute sounds (causing an alteration of *timbre*), but all sounds, whatever their pitch, suffer a retardation of a quarter of a wave. On the other hand Prof. Helmholtz, by a theory apparently more complete, finds that all sounds are weakened nearly in the same proportion, and that the difference of phase introduced must be very small. M. Koening has recently made experiments with a view to decide the question. He substitutes two tuning-forks, A and B, for the membranes of two associated telephones, and vibrates A with the bow; at once B enters into vibration, and one may, either by observing successively with an optical comparing instrument, the vibrations of A and B, or by arranging A and B as in the well-known experiment of M. Lissajous for composition of rectangular vibratory movements, measure the difference of phase of the tuning-forks, which is found exactly equal to a quarter of a wave-length. An experiment on complex sounds was made by changing one fork Ut_1 for fork Ut_4 so as to produce simultaneously the sounds 1 and 8 before the bar of a telephone. The difference of phase was still found equal to a quarter of a wave. Thus Du Bois Reymond's view is more in accord with experiment than that of Helmholtz.

ACCORDING to Herr Kohlrausch (*Ann. der Physik*, No. 6) well-defined tones may be produced in a simple way by only two impulses. Place two fingers of the hand loosely together, so that the end of the nails are about on a level, and then tap gently on the table, the proper tone of this having been deadened as much as possible by means of books, or sitting on it, or otherwise. It will be readily felt that the two fingers seldom strike quite simultaneously, and with some attention one may hear (best if the tapping be repeated twice or thrice in a second) in addition to the noise, of indeterminate pitch, a very bald tone of pitch varying at first with the position of the fingers, but which, after a little practice, one can approximately fix. It is also possible to give a musical interval by tapping twice with the fingers differently adjusted; Herr Kohlrausch says he has often perceived differences of pitch to the extent of a semitone. Within the interval 15: 16, then, the tones of only two impulses can be accurately determined. Tapping with only one fingernail these tones entirely disappear; and one may therefore easily learn to hear them by tapping alternately with the one and with the two fingers.

IN a recent paper to the Belgian Academy M. Renard endeavours to fix the distinctive characters of calcite and dolomite in rocks which contain these two elements associated in microscopic individuals. After showing that the characters on which the distinction has been established hitherto are not satisfactory, he substitutes the character which dolomite has of appearing nearly always with the form of the original rhombohedron, whereas calcite never, one may say, affects this crystalline form. It results from his observations that the dolomites which do not belong to the normal type must be considered as mechanical mixtures of dolomite and calcite, and not as combinations in which the excess of one of the two constituent bases must be interpreted according to the laws of isomorphism. M. Renard supports his determinations by chemical researches under the microscope, and, in concluding, he points out that in the case of several dolomitic rocks of carboniferous limestone, the dolomitisation is due to an action posterior to the sedimentation of the calcareous elements.

WILLUGHBY, not Willoughby (as printed in last week's NATURE) is the name of the new society for reprinting scarce ornithological works, which takes its name from Francis Willughby, the pupil and patron of John Ray, who first edited and then translated his "Ornithologiæ Libri tres," besides his ichthyological works.

THE International African Association have just published a note by Dr. Dutrieux, of the Belgian African Expedition, on the subject of a parasitical cutaneous affection which he has had opportunities of observing during his journey. The parasite especially attacks oxen, whence it is called *founza ia ngômbé* (ox-worm). The negroes suffer a good deal from it, and it appears to burrow into different parts of their feet. When it is extracted, in consequence of their always going barefooted, they get very painful ulcers, which Dr. Dutrieux says are exceedingly difficult to cure.

THE new number of the *Indian Forester* contains a paper of much interest on the Banda Forests, and the continuation of another on the function of the pines and the larch in the production of soil. There is also a letter which furnishes some curious notes

on the coppicing powers of certain trees in dry and arid climates.

THE *Annual Report* of the Society of Arts for 1878-9, shows, as might be expected, that during the past session, a vast amount of good and useful work has been done under its auspices. As to the material condition of the Society the report is favourable, notwithstanding the badness of the times.

THE Report of the Auckland (N.Z.) Institute for 1878-9, speaks of the steady progress of the Society, and the increasing interest manifested by the public in its operations. Several valuable papers on New Zealand natural history have been read.

WE have received a number of little Guides for Science Teaching, issued by the Boston (U.S.) Society of Natural History. The enterprise is creditable to the Society, and the "Guides" seem to us to be handy and trustworthy. Some of them are reprints and second editions. They are—"About Pebbles," by Alpheus Wyatt; "Concerning a Few Common Plants," by G. L. Goodall: "Commercial and other Sponges," by A. Wyatt; a reprint of Mrs. Agassiz's "First Lesson in Natural History;" "Common Hydroids, Corals, and Echinoderms," by A. Wyatt. The last three are very fully illustrated.

WE have received from Mr. J. T. Peacock, the eminent grower of succulent plants, a list of the plants cultivated by him; these comprise cacti, agaves, yuccas, sempervivums, euphorbias, and in fact all plants of a succulent or fleshy nature, many of which have hitherto been much neglected by cultivators. The extent of Mr. Peacock's collection may be judged from the fact that at the present time portions are contained at Sudbury House, Kew, the Alexandra Palace, and the Botanical Gardens, Regent's Park. For the purpose of making this class of Plants more generally appreciated among amateurs Mr. Peacock intends sending the printed list to applicants who send an addressed halfpenny wrapper to Sudbury House, Hammersmith.

THE *Allgemeine Zeitung* reports important anthropological discoveries in Moravia. Excavations have been going on for some months back under the direction of Herr Carl Maschka, a specialist in these subjects, in the Shipka and Tschertowa Dira caves, near Stramberg. The discoveries, it is stated, have been made in layers, carrying the investigator back step by step to the palæolithic age. Stone and bronze weapons, with bones of a variety of animals belonging to different periods, appear to have been found in large numbers.

OWING to the great cost and often very inferior quality of gas, the *Colonies and India* states that for street lighting the electric light is coming into favour in many parts of Australia, and in South Africa particularly; and when the problem of subdividing the light for use in small houses is satisfactorily solved, it will find a wide field in which it can establish itself more rapidly than will be the case in England.

A JAPANESE paper states that some chemists have discovered a vein of silver at Yuigahara, in Kioto-Fu. The water of a pond in the neighbourhood being discoloured, their curiosity was excited as to the cause, and a search for minerals in the vicinity resulted in the discovery mentioned.

FROM the Third Annual Report of the Burton-on-Trent Natural History and Archæological Society, it seems to be in a prosperous condition. It forms one of the Midland Union of Natural History Societies, and the work it is doing is on the whole creditable.

THE additions to the Zoological Society's Gardens during the past week include two Crested Porcupines (*Hystrix cristata*) from West Africa, presented by Mr. Moses Boyle; a Black-winged Peafowl (*Pavo nigripennis*) from Cochin China, presented by the Hon. A. S. G. Canning, F.Z.S.; a Buff-backed Egret (*Ardea russata*), European, six Small-scaled Mastigures (*Uromastix microlepis*) from Busreh, presented by Capt. Burke, s.s. *Arcot;* a Gold Pheasant (*Thaumalea picta*) from China, presented by Mr. J. E. Liardet; two Common Barn Owls (*Strix flammea*), European, presented by Mr. R. A. Baldwin; an Indian Python (*Python molurus*) from India, a South American Rat Snake (*Spilotes variabilis*) from South America, presented by Mr. George Billett; two Elliot's Guinea Fowls (*Numida ellioti*), four Vulturine Guinea Fowls (*Numida vulturina*) from East Africa, deposited; a Striped Hyæna (*Hyæna striata*) from India, a Yellow-footed Rock Kangaroo (*Petrogale xanthopus*), four Black Swans (*Cygnus atratus*) from Australia, two Balearic Cranes (*Balearica pavonina*), four Rose-ringed Parrakeets (*Palæornis docilis*) from West Africa, two Siamese Pheasants (*Euplocamus prælatus*) from Siam, a Darwin's Pucras Pheasant (*Pucrasia darwini*) from China, purchased; a Japanese Deer (*Cervus sika*), born in the Gardens; three Australian Wild Ducks (*Anas superciliosa*), a Spotted-billed Duck (*Anas pœcilorhyncha*), six Rosy-billed Ducks (*Metopiana peposaca*), bred in the Gardens.

HOLLWAY'S NEW APPLICATION OF RAPID OXIDATION BY WHICH SULPHIDES ARE UTILISED AS FUEL[1]

THIS process has for its object the utilisation of the heat generated by the rapid oxidation of certain mineral substances, which have not hitherto been used as sources of heat for smelting operations. The heat thus obtained is employed in the reduction of the furnace charge, which may be composed partly of sulphides and partly of siliceous ores. A current of air is forced through molten sulphides, by which means they are very rapidly oxidised. Great heat is thus developed, rendering the process of smelting a self-supporting operation; therefore no extraneous fuel is required, excepting that employed in raising steam for the blowing engines; where, however, water power is available, steam can be dispensed with, in which case all the carbonaceous fuel necessary for the operation is a little coke to start the furnaces, which stands in the same relative position to the ores as wood does to coal in the lighting of an ordinary fire.

It is well known that pyritous minerals are readily combustible, but the best means of utilising the heat-producing property of metallic sulphides is not so apparent as would at first sight appear. Of these sulphides only iron pyrites is sufficiently combustible at a low temperature to burn in the open air, the mass being raised to the temperature at which the oxidation takes place solely by the union of sulphur and iron with atmospheric oxygen. In Spain there are numerous deposits of poor cupreous pyrites, and the Rio Tinto and Tharsis Companies annually treat, at their mines, about one million tons for the extraction of copper only, which does not average 2 per cent. The process employed consists essentially in roasting the pyrites in heaps in the open air, dissolving out the copper from the roasted material, and precipitating it from the solution by means of iron. These operations extend over several months; any gold or silver contained in the ore is lost, and the iron and sulphur are also wasted. The sulphur passes into the air as an obnoxious and annoying gas, desolating the country for miles around the works.

From the earliest ages, carbon has been considered a necessity in all metallurgical operations. The first reduction of metals by means of carbon forms a connecting link between the age of stone and the commencement of civilised art. It is well known that carbon burns at widely varying temperatures, as, for example, in our bodies, in a common coal fire, or in a furnace. A great deal of thought has been devoted to the subject of economising carbonaceous fuel, and great advances have been made in this direction; yet the expenditure of coal or coke necessary, say, to melt a given quantity of metal, still far exceeds the theoretical limit. The main causes of this discrepancy may be accounted for as follows:—

1. Only part of the oxygen of the air passing into a furnace, acts on the material to be burnt.

2. The oxygen is not brought in contact with the combustible matter with sufficient rapidity, to obtain the necessary temperature for the operation.

3. Gases pass off hot and unburnt. These are now, however, frequently utilised.

[1] Communicated by Mr. Hollway.

There is one metallurgical operation in which the first two sources of loss are avoided, viz., "Bessemer's," where, by blowing air through molten crude iron, a very high temperature is attained by the combustion of small quantities of carbon and silicon contained in the crude iron; this is, however, not the case in the process of puddling, where the oxidation is spread over a considerable period of time, although the same constituents are frequently burnt in similar proportions. But even in the Bessemer process the carbon is only half burned, and a large amount of heat escapes with the carbonic oxide and nitrogen.

When, however, thin streams of air are forced through molten sulphide of iron, lying on a tuyère hearth, a high temperature is produced by the perfect combustion which ensues in the midst of the sulphides, and no unburnt gases, excepting nitrogen and sulphur vapour, escape from the surface of the molten mass. The hot nitrogen and sulphurous acid may be caused to act upon iron pyrites and other mineral matter, and when pyrites is thus heated, an atom of sulphur held in feeble combination is in great part expelled, and thus is obtained molten protosulphide of iron, which is subsequently burnt by the oxygen of the air driven in at the lower part of the furnace, thereby producing the heat necessary for continuing the operation. The process may be defined as a system of fractional oxidation, in which the numerous constituents of a complex furnace charge can be separated from each other and concentrated in different parts of the apparatus, the heat necessary for the operation being obtained by the combustion of a portion of the less valuable constituents.

The principal ores of all our ordinary heavy metals, except manganese and tin, are sulphides. Iron, although largely occurring in an oxidised form, is abundantly found in combination with sulphur; and bisulphide of iron, or iron pyrites, is an example of sulphurous and combustible minerals. Associated with iron and sulphur in iron pyrites are invariably found small quantities of other metals, notably cobalt, nickel, copper, silver, gold, lead, zinc, and arsenic. Of these, zinc is almost as combustible as iron itself, while lead and arsenic readily volatilise as sulphides, and cobalt, nickel, and copper are distinctly less readily oxidisable than iron, while silver and gold do not oxidise under these conditions; hence, in supplying air to such material, the iron is the first of the elements to suffer oxidation, so that if the oxidation be arrested before the whole of the iron has been burnt, the cobalt, nickel, copper, silver, and gold present will be found in the unburnt portion. This principle finds a parallel in the Bessemer process of treating pig-iron for the manufacture of steel, where a current of air is caused to bubble up through a bath of molten crude iron, [the silicon is first oxidised, and is closely followed and to a great extent accompanied by the carbon, and no large amount of iron suffers oxidation, until the whole of the silicon and carbon have been burnt out of the molten material.

The experiments made at Messrs. Cammell's works, at Penistone, in a Bessemer converter, have proved that by blowing air through molten sulphide of iron, the iron and a portion of the sulphur are oxidised, and if the oxidation is arrested before the combustion of the iron is complete, a heavy matt or regulus is obtained, which contains but a small proportion of the iron of the ore, but practically the whole or the greater part of the copper and other less oxidisable metals. In one of these experiments the molten sulphides were run into the converter from a cupola, in which they had been previously melted, and the temperature was kept up until the operation was discontinued, viz., for a period of ten hours, without the use of any carbonaceous fuel, the heat being entirely derived from the oxidation of the iron and a portion of the sulphur of the lumps of pyrites, which were continuously thrown into the mouth of the converter. A Bessemer converter being unsuited for the collection of the gaseous products, the later experiments have been made in a series of cupola furnaces belonging to Messrs. John Brown and Company, Limited. These experiments have proved the possibility of obtaining a valuable regulus, a slag nearly free from copper, and a considerable quantity of crude sulphur. M. Pourcel, the well-known chemist of the Terrenoire Company, has also made some very interesting experiments, having treated by this method a cupriferous sulphide of antimony containing lead and zinc, using heavy spar and silica as fluxes; he obtained a regulus containing the whole of the copper in the form of sulphide, a slag of light specific gravity, and the lead, zinc, and antimony as two separate sublimates which were condensed in different parts of the apparatus, owing to the superior volatility of sulphide of lead over the oxides of antimony and zinc. In the experiments at Penistone and at Sheffield a cold blast of air was employed, and the gases which passed from the converter or furnace into the open air, carried away with them a large amount of heat. In practice, however, it would be economical to employ a hot blast, which could be heated by the waste heat from the escaping gases. It is remarkable that the least valuable metals, viz., iron and zinc, generate by their combustion the largest quantities of heat.

The process may be employed for the reduction of even the more volatile metals; for example, Mr. A. H. Allen, of Sheffield, has thus obtained metallic antimony simply by the oxidation of sulphide of antimony. It is well known that sulphide of lead reacts upon oxide of lead with the production of metallic lead and sulphurous acid. If, therefore, a limited amount of air is blown into molten sulphide of lead, the oxide thus formed in the lower part of the furnace will, in passing upward, come in contact with the hot sulphide of lead, and metallic lead will result, with the evolution of sulphurous acid. The furnace having a quiescent hearth below the tuyères, the metallic lead will collect there, and can be from time to time withdrawn. A limited amount of air must be employed, because if it is driven in too quickly, the sulphide of lead will rapidly distil off. In thus treating argentiferous lead ores, the silver (and gold if present) would be found with the first metallic lead reduced. When thus treating galena the furnace should have a basic lining.

The process is peculiarly suitable:—

1st. For the treatment of metalliferous substances which cannot be advantageously treated by other processes. For the extraction of sulphur by distillation, and simultaneously for the concentration and separation of cobalt, nickel, copper, silver, and gold from minerals in the form of metallic regulus; while lead, zinc, antimony, arsenic, &c., accrue in the sublimates.

2nd. For the treatment of complex ores, for example—Grey antimonial copper ores, such as those experimented on by M. Pourcel. Ores similar to those worked at the well-known Bottino Mines, Seravezza, in the Italian Apennines, which contain thirteen or fourteen heavy metals, including silver and lead, for which latter alone they have been worked for centuries. The blende of lead mines, in Derbyshire termed "muck," usually thrown away by the miners, because the large quantity of lead with which it is associated renders the zinc obtained from it worthless.

3rd. For the treatment of auriferous and argentiferous pyrites. It is well-known that in practice it is not possible to obtain the whole of the gold from pyrites by amalgamation with quicksilver, because the presence of sulphur and arsenic sickens and flours the mercury, whereas by fusion the whole of the silver and gold present is obtained.

4th. For the treatment of pyrites containing even only small percentages of cobalt, nickel, and copper, which are thus concentrated into a rich regulus, whereas this result is now only obtained by very tedious processes of alternate roasting and reduction. Such ores containing 10 per cent. and even 12 per cent. of copper exist in South America and many other parts of the world, but are not at present capable of economic treatment, owing to the difficulty of obtaining a sufficient supply of cheap fuel. The process can also be advantageously applied to the treatment of richer ores of copper such as are at present smelted at Swansea.

5th. For the treatment of poor lead ores. If such ores are added to a furnace charge of cupreous pyrites, the silica they contain will be utilised and combine with the resulting oxide of iron to form slag, the galena will be volatilised and be recovered as a sublimate, while any silver present will enrich the regulus. At present, by a costly process of crushing and washing these ores, the galena is concentrated, although a large proportion is left with the *débris*, and passes with the water into the streams, rendering the existence of fish in such waters impossible. The water power now used for washing the ore could, in many cases, be employed for producing the blast.

When thus treating cupriferous iron pyrites, four products are obtained:—

1st. A matt or regulus containing from 30 to 50 per cent. of copper, any traces of cobalt, nickel, silver, or gold the ore may contain, the rest of it being iron and sulphur; it has a specific gravity of 4½ to 5.

2nd. A slag consisting of silicate of iron from the resulting oxide of iron combined with the siliceous matters contained in the ore and the fluxes added.

3rd. Sublimed sulphur, more or less mixed with volatile compounds of lead, zinc, and arsenic.

4th. Sulphurous gases, consisting mainly of sulphurous acid and nitrogen.

The regulus closely resembles, and will replace, the coarse metal of the Swansea copper process, which is now only obtained at considerable cost of labour, time, and carbonaceous fuel. When, however, sulphides of iron and copper present in the bath are treated continuously by a blast of air, a point is at length arrived at when the whole of the iron is oxidised, and the regulus in the bath consists of sub-sulphide of copper. If, now, a limited supply of air is introduced, the copper is reduced to the metallic state with the evolution of sulphurous acid.

The slag obtained in the Penistone experiments was essentially silicate of iron, containing about 50 per cent. of iron and 29 per cent. of silica. It had a density of about 3 8 to 4, and was in composition somewhat allied to the copper-smelter's ore furnace slag and to the tap-cinder of the iron-puddler. By the addition of calcareous materials, the specific gravity of the slag is so reduced as to cause it to separate readily from the regulus which collects below it. In one of the later experiments, when lime was used, the proportion of copper lost in the slag was very small. This is, of course, a most important point, for when dealing with ores containing but little copper, the presence of even a small percentage in the slag means the loss of a considerable proportion of the copper present. These slags can be utilised for the manufacture of steel, being practically siliceous iron ores free from phosphorus, and their reduction in a blast furnace can be profitably effected, as the proportion of iron present is high as compared with the weight of the material; indeed, it may be possible to reduce them while in a molten state.

By re-subliming the crude sulphur, it can be freed from all impurities except arsenic, and at the works of Messrs. John Hutchinson and Co., Widnes, this is eliminated by means of polysulphide of calcium.

As a certain proportion of the sulphur of the minerals suffers combustion, the resulting sulphurous gases contain from 14 to 15 per cent. of sulphurous acid, and hence the proportion of sulphurous acid to nitrogen is nearly identical with that of the gases produced by roasting pyrites in the kilns employed by vitriol manufacturers, and can, therefore, be used with equal advantage for the production of vitriol in leaden chambers. This appears to be the simplest solution of the great problem how to smelt copper without causing a nuisance to the surrounding neighbourhood, although a similar result might be obtained by collecting and liquefying the sulphurous acid.

The more incombustible materials it is found practicable to employ without too great a loss of temperature, the wider will become the application for the process; for there are many ores, including silicates and carbonates, containing metals in the form of oxides, which might be conveniently smelted by mixing them with a sufficient proportion of pyritous ores to effect their reduction; in fact, one of the chief practical questions connected with this process is how far it may be trusted to effect the smelting of ores or furnace charges containing comparatively moderate proportions of sulphides. It is evident that it will almost entirely obviate the necessity for using carbonaceous fuel, at least as far as the production of a regulus is concerned, and consequently the localities in which smelting operations may be advantageously carried on are thus greatly multiplied. One of its chief merits is that it is equally applicable with comparatively little extra cost in the working, to very poor and very rich ores, for however small the resulting regulus, it will contain nearly the whole of the cobalt, nickel, copper, silver, and gold present in the furnace charge, while any lead, zinc, antimony, and arsenic will be obtained as sublimates.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

THE authorities at Owens College, Manchester, and of the Yorkshire College of Science, Leeds, have already taken the initiatory steps for preparing a constitution of the new University for the North of England, for which a charter has recently been granted. The Council of the Owens College have appointed a committee of their body, and on Friday they met in conference at the college in Manchester, with representatives of the Council of the Yorkshire College of Science, for the purpose of considering a draft constitution for the new institution. The basis of the deliberations of the conference is to be found in the series of suggestions contained in an appendix to the memorial which was presented to the Privy Council some time ago, but various questions will come before the meeting for consideration, including the power of granting degrees to women and the better representation of the graduates and the teaching staff upon the Board of Governors. Considerable progress was made on Friday in preparing suggestions for a draft of a proposed charter, though each of the clauses was very fully discussed before adoption. When the conference has completed its task it will report to the Council previous to the scheme being submitted to the Law Officers of the Crown.

MR. W. N. HARTLEY, of King's College, London, has been appointed Professor of Theoretical and Practical Chemistry in the Royal College of Science, Dublin, and enters upon his duties at the beginning of the October term.

THE following students have passed the examinations which entitle them to the distinction of "Associate of the Royal School of Mines":—In the Mining and Metallurgical Divisions: Mirza Mehdy Khan. In the Mining Division: W. E. Benton, A. G. Charleton, A. D. Ellis, E. N. Fell, H. B. Statter, H. Strickland. In the Metallurgical Division: W. B. M. Davidson, A. H. Fison, F. W. Grey, E. Halse, E. W. Harvey, Malcolm Hill, J. H. Lucas, Walter Marsh, A. Gordon Salamon. The two Royal Scholarships of 15*l.* each have been awarded to J. J. Hood and J. F. Wilkinson. The Royal Scholarship of 25*l.* has been awarded to Ralph G. Scott; the De la Beche Medal for Mining to A. D. Ellis; and the Murchison Medal for Geology to B. Mott.

SCIENTIFIC SERIALS

American Journal of Science and Arts, June.—Reviewing what is now known of extra digits in the feet of the modern horse Prof. Marsh says the instances fall naturally into two groups: the first comprising simply cases of reduplication (like that of the occasional extra-finger in the human hand), not satisfactorily explained as yet; the second includes cases where a true digit is formed, the component bones in normal position and relation, and such instances seem clearly due to reversion to some ancestral type. Extra digits appear more frequently on the fore feet than the hind feet (as a study of fossils would lead one to expect), and more frequently on the inside of the main digit, the outer splint remaining rudimentary (this, again, is opposed to the general law of reduction in the ungulate foot).—Mr. Sargent's paper on the forests of Central Nevada has been elsewhere referred to, and we further note that Prof. J. C. Draper writes on the dark lines of oxygen in the solar spectrum on the less refrangible side of *G* (in the regions about λ 4317 and λ 4319); Mr. Christy seeks an answer to the question "Are cinnabar deposits produced by sublimation, or are they deposited from solution?" and concludes that they are the immediate result of the action of solutions of alkaline carbonates containing also alkaline sulphides; Mr. Hodges suggests a new absolute galvanometer.—Mr. Sawyer contributes a first catalogue of radiant points of meteors (from observations at Cambridge during the last two years); and Maria Mitchell notes on the satellites of Saturn.—A recent paper published in Brazil, by Mr. Derby, on the geology of the Lower Arizonas, is summarised by Mr. Rathbun.

Journal of the Franklin Institute, June.—We note here the following:—Peaucellier's compound compass and other linkages, by Prof. Marks.—Some experiments on alloys of silver with embrittling metals, by Mr. Onterbridge.—Phosphorus in coal, by Mr. McCreath.—On the determination of silicon in pig-iron and steel, by Dr. Drown.

Reale Istituto Lombardo di Scienze e Lettere. Rendiconti. Vol. xii. fasc. xi.-xii.—On an integral formula, by Prof. Beltrami.—On tetrahedral systems, by S. Aschieri.—Atrophy and degeneration, by Prof. Sangalli.—On a parasite Colothurnia of the branchiæ of our crabs, by Prof. Maggi.—A microphyte on Hesperideæ, by Dr. Cattarneo.—The infirmity of Torquato Tasso, by Prof. Conadi.—A new bird for the Lombardy fauna, by Prof. Pavesi.—On the centre of forces in the plane, by Prof. Bardelli.—On the cortical iridian centre in birds, by S. Ortel.—New series of researches on the pelagic fauna of the Italian lakes, by Prof. Pavesi.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, June 19.—"Preliminary Note on a New Tide-predicter." By E. Roberts, F.R.A.S. (*Nautical Almanac Office.*) Communicated by Prof. G. G. Stokes, M.A., Sec. R.S., &c.

The Indian Survey Department having undertaken the superintendence of tide-registration around the whole sea-board of India and at the port of Aden, and also the reduction of the observations by the method of harmonic analysis, with the view to the prediction of the tides for the whole of the ports, it became a matter of necessity, in order to save the large outlay which the numerical operation of their prediction would have involved, that an instrument should be constructed to delineate the predictions.

Accordingly, on the recommendation of the Surveyor-General of India, I was desired to design, and to undertake the construction of, an instrument to include a sufficient number of tide-components to predict the Indian Ocean tides with all the accuracy necessary for practical purposes.

The present machine is the outcome of the recommendation.

The instrument combines the following twenty tide-components :—

The mean lunar semidiurnal ;
The first and second overtides of the mean lunar semidiurnal ;
Two *elliptic* lunar semidiurnal ;
Two *evectional* lunar semidiurnal ;
One *variational* lunar semidiurnal ;
The mean solar diurnal ;
The mean solar semidiurnal ;
The lunisolar semidiurnal ;
The lunisolar diurnal ;
The lunar diurnal ;
The solar diurnal ;
One lunisolar elliptic diurnal ;
One lunar elliptic diurnal ;
One compound (Helmholtz) lunisolar semidiurnal ;
One compound (Helmholtz) lunisolar quarter-diurnal ;
The solar annual ; and
The solar semiannual.

Strictly speaking, there is no sensible astronomical tide-component of twenty-four mean-solar hours' period, but for the purposes of prediction it is necessary to include such a term, a very regular and sensible result of this period being obtained in the analysis, due probably to wind or temperature. The same remark applies partially to the solar annual and the solar semiannual, the theoretical tides of these periods being very small ; the analysed results, however, are of considerable value, being due probably to the effect of rainfall and the regularity of the monsoons. These three components should, therefore, be regarded more as meteorological than astronomical.

The stipulation that the scale for heights should be one inch per foot range for Bombay necessitated a recording barrel of some 18 inches at least ; the actual length adopted for the instrument, however, is 22 inches. The delineation of the curves on such a large scale rendered necessary some modification of the system of excentric pulleys, as fitted on the tide-predicter of the British Association. It was at first contemplated to fit parallel slides only to the larger of the tidal components ; the whole of them have, however, been so provided.

The chief difficulty in the construction of the machine is the finding, within reasonable limits, of proportions which shall represent with sufficient accuracy the periods of the several components, in order that the machine may be used for a considerable period of prediction—say, for twelve months. Very great success has been attained in this respect in the present instrument. For instance, the error of the period of the chief component (the mean lunar semidiurnal) relatively to the mean solar semidurnal is inappreciable during a whole year's predictions, amounting to about $0^{\circ}\cdot10$ only in a period of fifty years. The largest deviation from strict accuracy is $0^{\circ}\cdot37$, after a run representing twelve months. This is, however, of one of the very small components, and insensible in its results. This part of the design may be therefore regarded as practically perfect.

Each component is provided for setting with a crank, in which a sliding piece is fitted, carrying a steel guiding-pin. The guiding-pin is thrown out by means of a fine-cut screw and micrometer head. An improved parallel slide, carrying a pulley, is also fitted to each component. The guiding-pin works between two parallel adjustable steel jaws at the back of the pulley frame. The pulley frame is fitted with a balance-weight, so that its centre of gravity is in a vertical line through the pulley's axis. The whole slide is counterpoised by a cord and weight, passing over pulleys, in order to relieve the guiding-pin of all strain and to prevent wear. The steel bar of the pulley slide moves freely in two guides drilled out nearly their entire length to reduce the touching parts to a minimum. The other side of the pulley slide is kept in position by a projecting fork or guide, travelling with freedom along a narrow flat brass bar. Both the brass bar guide and the steel rod guide are divided to millimetres ; the brass bar for approximate, and the steel rod for the accurate, adjustment of the throw of the crank-pin, for which purpose the upper guide of the steel rod is furnished with a vernier. The milled head of the micrometer-screw is also divided and may be used with the divisions on the brass bar guide. The pulley frame is movable on its steel rod, for the purposes of the perfect adjustment of the pulley about the centre of motion of the axis of the crank.

The axis of the crank carries behind the main plate a fine-toothed wheel, fitted on a slotted cone, with a milled nut for clamping the wheel on its axis. The toothed wheel is driven by an endless screw, carrying a bevelled wheel, which is itself driven by another bevelled wheel on one of the four main axes of the machine. The endless screws and main axes are fitted with counter pivots.

At the back of the machine are fitted the setting dials. Each dial is toothed round its outer edge and movable round its centre by a pinion for adjustment. The axis of the component projects through the setting dial, and carries a steel pointer for setting.

A fine flexible wire fixed to a large screw-head passes alternately under and over the pulleys of the lower and upper series of components, and carries an ink-bottle at its free end. The ink-bottle, fitted with a fine glass point, travels in a geometrical slide, and is suspended to give just sufficient pressure to ensure contact on the paper of the recording barrel.

The recording barrel is fitted with brass pins at equidistant intervals to form the time indications on the paper by perforation. An index for setting is fitted behind the machine at the top of the recording barrel.

The paper, which is continuous and supplied from a reel, passes round two grooved rollers at the back of the main barrel, and is held in position whilst the pins enter the paper, and after receiving the curves is wound round the haul-off drum. The haul-off drum rests on toothed driving-wheels, and by friction turns and slips to accommodate itself at a proper tension to receive the recorded paper. Motion is given to the whole system of wheelwork through the horizontal centre main shaft from a system of clockwork driving-gear at the bottom of the machine, the whole being driven by a weight calculated at about 4 cwt., and controlled by a fan. A warning bell sounds when the weight is nearly run down. The length of the barrel round which the cord is wound is sufficient to give 15,000 turns of the main shaft. This corresponds to about three months' run of curves, and will occupy about one hour to run off. A year's tide-curves for any port will thus occupy about four hours.

The setting of the machine for the prediction of the tide-curves of any port for which the tide-components are known is as follows :—The dials are first turned so that the epoch or time of maximum is exactly under or above the highest or lowest point according as the component is situated on the upper or lower row of components. The cranks are set vertically (the slotted cone of the wheel on the axis having been first released) and the guide-pin thrown out to its proper range to represent the half-amplitude of the component. The proper positions of the hands having been previously determined by calculation for the time of starting, the hands are set and the slotted cones tightened up. The recording barrel is then set to the time and the wheelwork set in motion. The complete setting occupies only a few minutes.

The large dial in the centre is for showing the progress of the record, which can be marked occasionally to facilitate the entry of the dates on the record after its removal from the machine. A few supplementary pins are inserted in the barrel for the better distinction of the hours. Two speeds of travel can be given to the paper, viz., 1 inch and $\frac{1}{2}$ inch per hour. A fixed rod near the recording pen carries ruling pens for the tracing of base lines, such as dock sills, river bars, or mean tide-levels, or if desired can rule the paper throughout its entire depth to represent feet, metres, &c.

To Sir William Thomson my thanks are due for the improved parallel slide and other details, and also to Mr. Légé (the maker of the instrument) for the design of the wheel-gearing.

"The Motion of Two Spheres in a Fluid." By W. M. Hicks, M.A., St. John's College, Cambridge. Communicated by Prof. J. Clerk Maxwell, F.R.S., Professor of Experimental Physics in the University of Cambridge.

The investigation is based on the lemma that the image of a source in an infinite fluid in presence of a sphere consists of a source at the inverse point of the former, and a line sink thence to the centre of the sphere. From this is deduced the image of a doublet whose axis passes through the centre of the sphere, and of one whose axis is perpendicular to this. Thence is found the kinetic energy of motion of two spheres and fluid in which they are immersed, and properties of the motion deduced by Lagrange's equations. Amongst other things is considered the action between vibrating spheres.

Physical Society, June 28.—Prof. W. G. Adams in the chair. New Members: Mr. J. F. Moulton, Mr. J. J. Eastwick.—Prof. W. G. Adams exhibited his new measuring polariscope. It consists of three principal parts. The lower section consists of a mirror, a lens, a Nicol's prism, and two other lenses. The upper section consists of lenses and Nicol's prisms arranged in the reverse order. Each lens and Nicol's prism is supported separately by screws, and its position can be altered independently of the others. These two parts form a complete polariscope. Besides these there is a middle piece consisting of two lenses (nearly hemispheres) forming a box to inclose the crystal immersed in oils, their curved surfaces being concentric. The whole middle piece is supported on the tubes of the upper and lower portions, and may be turned about the optical axis of the instrument. The vertical graduated circle carrying the central lenses and crystal may be turned through any angle about its horizontal axis. By means of an arc fastened perpendicularly on the graduated circle with the centre at the centre of curvature of the central lenses, the crystal may be turned about another horizontal axis at right angles to the former, so that the crystal and the central lenses can be turned about each of three axes which are mutually at right angles. By means of a system of toothed wheels in gear with the rims of the central lenses, the crystal and central lenses may be turned separately about the optic axes of the instrument, so as to bring the planes of the optic axes of a biaxial crystal parallel to the plane of the vertical graduated circle.—Sir John Conroy, Bart., read a paper on the distribution of heat in the spectrum. After referring to Dr. J. W. Draper's supposition that all the rays in the spectrum have the same heating effect, and to his statement that owing to the unequal dispersion of the prism for rays of different refrangibility, the method that has been usual for determining the calorific intensity of the various parts of the spectrum is an essentially defective one; the author described a graphical method for eliminating the effect of the unequal dispersion of the prisms, and showed that from MM. Fizeau and Foucault's measurements, and also from those of Lamansky and Prof. Tyndall, that the maximum intensity is about the middle of the visible spectrum, and not at the red end; and, further, that the curves given by various observers as representing the intensity of the heat in different portions of the spectrum, are in reality the "dispersion curves" for the particular prisms employed.—Capt. Abney, R.E., called attention to his published paper on the measurement of the so-called thermo-spectrum, wherein he shows that the distribution of heat in the spectrum is a misnomer, and that what was really measured by Lemansky and Tyndall was the energy absorbed by the lamp-black and the absorption due to the prisms used. He considered that there was no inherent heat in the spectrum. He found that Dr. Draper had not taken into account the amplitude. Prof. Guthrie said that Capt. Abney had expressed what many thought, namely, that heat was radiant energy.—Mr. Grant then described an investigation which he had made into the induction lines round two parallel coils of wire. In the primary coil an intermittent current of electricity from a Leclanché battery flowed; and in the secondary a telephone was connected up to detect the induction sounds. With this apparatus he found that with the coils kept parallel to each other, there were lines, or rather a surface of minimum induction surrounding the primary, and that if the secondary were placed in these lines hardly any induction noise could be detected. A diagram representing a medial section through the coils showed the lines to proceed from the wire of the coils in two curves resembling parabolas—one from each cross-section of the wire outwards.—Dr. Shettle then described his experiments proving the lines of force in a bar-magnet to run spirally round the bar between the equator and poles, the equator being decentred and oblique across the bar, as shown by diagrams.—Prof. Rowland, of Baltimore, made some observations on the new theory of terrestrial magnetism of Professors Ayrton and Perry. He said the experiments on which the theory was founded had been attributed to Helmholtz, but they were entirely his own, he having gone to Berlin to make them. The new theory had occurred to himself on making these experiments, but he had rejected it because he found that the potential which the earth's surface would require to have would not only cause violent planetary disturbances, but, by mutual repulsion, drive objects off the earth. He had made also an experiment to see if absolute motion of electricity would cause magnetisation, but failed to get any effect from it. Then he resorted to calculation to find the magnetic effect of relative motion by rotation of a charged sphere of perfect magnetic permeability that is more magnetic than iron. He found that when the sphere was uniformly charged and rotating there would be a magnetic field in its interior; but instead of the result of Messrs. Ayrton and Perry, that if the earth were charged to a potential of, he believed, 10^8 volts relatively to interplanetary space, the earth's magnetism would be what it is, he found the necessary charge to be 61×10^{15} volts. In the ordinary atmosphere this potential would produce a spark nine million miles long and discharge across to the moon. If the moon were electrified to the same degree the mutual repulsion would overcome the force of gravity between them. He therefore considered terrestrial magnetism to be still a mystery. He had also thought that the aurora borealis might be explained by supposing the upper regions of the earth's atmosphere electrified. The winds carrying the upper strata towards the poles, electricity would condense there. This hypothesis was still tenable. Prof. Ayrton said that whether or not the new theory of magnetism should be so rejected depended on whether or not Prof. Rowland's calculations, or those of himself and Prof. Perry were wrong. It had been found by Sir William Thomson, from experiments at Arran, that the earth was electrified with respect to the air, and that there is a difference of potential of 30 volts between earth and air for each foot of ascent. This gave 1360×10^{13} centimetre-gramme-second electrostatic units as the potential of the earth. The new theory required the potential to be 1011×10^{11}, supposing the earth to be of solid iron, or about fourteen times more—a wide margin. Prof. Rowland said he had not seen the calculations of Professors Ayrton and Perry yet, but he believed his results to be correct, as he had checked them in various ways.—Mr. Bailley exhibited a modification of Arago's experiment, in which a copper disk is caused to rotate continuously by changing the polarity of four electro-magnets underneath by a revolving commutator.—Mr. Conrad Cooke exhibited a single voltaic element showing the internal current. This is done by forming the glass vessel containing the element into a helical tube between the poles, and hanging a galvanometer needle in the interior of the helix; the internal current deflects the needle.

Geological Society, June 25.—Prof. P. Martin Duncan, F.R.S., vice-president, in the chair.—Edward Garlick was elected a Fellow of the Society.—The following communications were read:—On the evidence that certain species of *Ichthyosaurus* were viviparous, by Prof. H. G. Seeley, F.R.S., F.G.S.—On *Rhamphocephalus prestwichi*, Seeley, an Ornithosaurian from the Stonesfield Slate of Kineton, by Prof. H. G. Seeley, F.R.S.—A contribution to South American geology, by George Attwood, F.G.S. The paper describes a line of country in Spanish Guayana, Venezuela, S.A., commencing from a small town called "the Port of Las Tablas," on the Orinoco River, extending about 150 miles, and consisting of a series of crystalline and altered rocks. Syenite is the first rock met with, and then are found granite, quartz-diorite, hæmatite, and magnetic iron ores, gneiss, slaty rocks, gabbro, and diabase. In the diabase the quartz veins are found to contain large quantities of gold mixed with the vein matter; the alluvial soil in the neighbourhood of the quartz veins also contains gold nuggets and small grains of gold. Although quartz veins are found in great numbers from the river to the interior, none of them have so far

been found to contain gold in any appreciable quantity until the diabase is met with. All the rocks analysed show a higher percentage of silica than is generally found in other localities. Three analyses made from one piece of diabase showing two distinct lines of alteration by weathering (on the original rock), prove that silica is readily dissolved under atmospheric influences, whilst alumina is not. Iron oxides contain more oxygen near the surface than below it. Lime and magnesia are both readily soluble, but lime much more so than magnesia. Soda is more sensitive to weathering than potash. The rocks contain *more combined as well as uncombined* water on their surface than when sheltered from atmospheric influences. The paper was accompanied by an appendix on the microscopical structure of some of the varieties of rocks by Prof. Bonney.—On the so-called Midford Sands, by James Buckman, F.L.S.—On the physical geography of the north-east of England in permian and triassic times, by E. Wilson, F.G.S. In this paper the author seeks to utilise the information he has acquired from the study of the permian and triassic rocks of the above district, towards solving some of the difficult and much debated questions as to their origin. One of the main objects of the paper is to establish the pre-permian origin of the Pennine Chain.—The formation of rock-basins, by J. D. Kendall, C.E., F.G.S.—On the diorites of the Warwickshire coal-field, by S. Allport, F.G.S.—On *Lepidodiscus lebouri*, a new species of *Agelacrinites*, from the carboniferous series of Northumberland, by W. Percy Sladen, F.G.S., F.L.S.—On the ancient river-deposit of the Amazon, by C. Barrington Brown, A.R.S.M., F.G.S. The author described a series of alluvial deposits, varying in thickness from 10 to 160 feet, which have been cut through by the river, and form a series of cliffs, giving rise to striking and characteristic scenery. The succession of beds exposed in these cliffs was illustrated by a number of sections, and it was shown that the strata in question must have been deposited by river action. It was then pointed out that the river is performing two classes of work, namely, cutting away the older sheets of alluvial matter, and depositing the materials derived from them at a much lower level. The interesting phenomena of the cutting of curves by the river, and the abandonment by the river of parts of these curves, giving rise to the formation of lakes, was fully explained; and in conclusion the author showed by a map what vast areas in South America have thus been covered by these alluvial deposits.—The glacial deposits of Cromer, by Clement Reid, F.G.S.—On a disturbance of the chalk at Trowse, near Norwich, by Horace R. Woodward, F.G.S.—The submerged forest of Barnstaple Bay, by Townshend M. Hall, F.G.S.—On a section of boulder clay and gravels at Ballygalley Head, and an inquiry as to the proper classification of the Irish drift, by T. Mellard Reade, C.E., F.G.S.—On the augitic rocks of the Canary Islands, by Prof. Salvador Calderon. Communicated by the President. As the result of a long investigation of the eruptive rocks of the Canaries, and especially of Las Palmas, the author has come to the conclusion that there are two groups of such rocks in those islands, an older one, characterised by the presence of hornblende, and a newer, containing augite. In the latter he finds the essential minerals to be plagioclase, augite, magnetite, olivine, sanidine, and nepheline; and he distinguishes among them the following kinds of rocks, all of which have their characteristic minerals imbedded in a paste of augite and plagioclase:—(1) *Augite-andesite*, with a small quantity of sanidine; (2) *Tephrine*, with no sanidine, but abundance of nepheline; (3) *Basanite*, with some peridote; (4) *Nepheline-basalt*, with abundance of peridote; (5) *Dolerite*, crystalline, characterised by the disappearance of nepheline, the abundance of peridote and porphyritically imbedded plagioclase, and with porphyritically imbedded individuals of augite and olivine; (6) *Felspathic basalt* (like 5), but semicrystalline; and (7) Essentially olivinic modern lavas.—On the Cambrian (Sedgw.) and Silurian beds of the Dee valley, as compared with those of the Lake-district, by J. E. Marr, B.A., F.G.S.—On some superficial deposits in the neighbourhood of Evesham, by the Rev. A. H. Winnington Ingram, M.A., F.G.S.—Descriptions of palæozoic corals from Northern Queensland, with observations on the genus *Stenopora*, by Prof. H. A. Nicholson, M.D., D.Sc., F.G.S., and R. Etheridge, jun., F.G.S. The corals described in this paper were in part collected by the late Mr. Daintree, chiefly from the limestone of the Broken River, regarded as of Devonian age, and in part by Mr. R. L. Jack, from various sources, namely, the Bowen River coal-field, in beds probably of permo-carboniferous age, the Fanning River limestone (Devonian), and the Arthur's Creek limestone (permo-carboniferous). Mr. Daintree's collection also contained corals in the chloritic rock of the Gympsie gold-field. From the Coral Creek, Bowen River coal-field, the authors record *Stenopora ovata*, Lonsd., and *S. jackii*, sp. n.; from the Fanning River limestone, *Heliolites porosus*, Goldf., and *Pachypora meridionalis*, sp. n.; from the Gympsie chloritic rock, *Stenopora?* sp. ind.; from the Broken River limestone, *Favosites gothlandicus*, vars. Lam., *Heliolites porosus*, Goldf., *H. plasmoporoides*, sp. n., *H. Daintreei*, sp. n., *Heliolites*, sp. ind., and *Araeopora australis*, sp. n.; from the Arthur's Creek limestone, Burdekin Down, *Alveolites* (*Pachypora?*), sp., near *A. robustus*, Rom., *Alveolites*, sp. (lobate form), *Aulopora repens*, M.-Edw. and H., *Heliolites porosus*, Goldf., and vars., *Lithostrotion*, sp. ind., *Pachypora meridionalis*, *Trachypora*, sp. ind., and species of *Cannopora* and *Stromatopora*. The genus *Araeopora* is proposed as a new group; the genus *Stenopora* is made the subject of a long discussion; and the geological characters of the deposits from which the fossils are derived are indicated and discussed.

Meteorological Society, June 18.—Mr. C. Greaves, F.G.S., president, in the chair.—Lieut. A. Carpenter, H. Dodd, Capt. D. Galton, F.R.S., S. B. Goslin, A. Gray, Capt. Marshall Hall, W. L. MacGregor, and Rev. W. P. Robinson, D.D., were elected Fellows of the Society.—The following papers were read:—Report on the International Meteorological Congress held at Rome, April, 1879, by Robert H. Scott, F.R.S.—Thermometer exposure: Wall *versus* Stevenson screens, by William Marriott, F.M.S. It being the practice of some observers to expose their thermometers on walls facing north, it seemed a suitable object of inquiry whether instruments so placed gave results comparable with those obtained from thermometers in a Stevenson stand in the open. A pair of meteorological office wall screens were fixed to the brick wall of an outhouse with a northern aspect, so that the screens were in the shade, except in the morning and afternoon of the summer months. The Stevenson screen was on a grass plot 17 feet square, and about 50 feet north of the wall screen. The paper contains the results of the comparison of the maximum and minimum temperatures in the wall screen with those in the Stevenson screen for the twelve months ending March 31, 1879. The figures show that the mean daily maximum temperature on the wall is below that in the open, the monthly differences varying from 0°·0 to − 2°·1, that for the twelve months being − 1°·0. The minimum temperature on the wall was mostly higher than in the Stevenson stand, the differences varying from − 0°·1 to + 1°·3, the mean for the year being + 0°·5. The individual differences, however, are sometimes much greater, the maximum temperature on the wall being considerably lower than that in the stand. For instance, the difference exceeded 4°·0 five times in September, and four times in March, the greatest being 6°·7; these extremes occurred on fine calm days. The minimum temperature on the wall was more than 2°·0 higher than that in the Stevenson stand on five occasions in June, seven in July, and four in September. The mean daily range of temperature on the wall for the twelve months was 1°·4 less than in the stand in the open. The greatest difference was on March 9, when the range on the wall was 8°·5 less than in the stand. These results seem to show that, although the mean temperature may be roughly ascertained from thermometers shaded by a wall with a northern aspect, this method of exposure affords less sensitive indications than those obtained from instruments in a properly exposed Stevenson stand.—On the Hurricane at Mauritius, on March 20th—21st, 1879, by C. Meldrum, LL.D., F.R.S.—On a remarkable disturbance of Barometric Pressure, observed at the Royal Observatory, Greenwich, on May 18th, 1878, by W. Ellis, F.R.A.S.—Meteorology of Mozufferpore, Tirhoot, 1878, by C. N. Pearson, F.M.S.—Meteorological Observations made on the Peak of Teneriffe, by Dr. W. Marcet, F.R.S.—On the temperature of the Atlantic during December, 1877 and 1878, by Capt. H. Toynbee, F.R.A.S.

Entomological Society, July 2.—Sir Jno. Lubbock, Bart., V.P.R.S., president, in the chair.—Mr. Vincent Robert Perkins, of South Belgravia, was elected as an Ordinary Member.—Mr. S. Stevens exhibited living specimens of *Tillus unifasciatus* taken at Norwood.—Mr. McLachlan contributed some further remarks respecting the sculptured pebbles from Lac Léman referred to at the last meeting of the Society.—A number of the perfect insects forwarded by Prof. Forel proved to be *Tinodes lurida*, Curt., a common insect generally on the margins of

lakes and rivers.—Mr. W. L. Distant exhibited a specimen of *Papilio hystaspes*, Feld., taken at sea during a calm thirty miles from Singapore and nine miles from the nearest land.—Mr. W. Cole exhibited a remarkable variety of *Pyrameis cardui*, Linn., taken in Essex.—The Secretary exhibited, on the part of Lord Walsingham, some specimens of a remarkable species of *Tipulidæ* (*Bittacomorpha clavipes*, Fab.) possessing greatly enlarged tarsal joints, captured at Pitt River, California.—Sir Sydney Saunders communicated some additional explanations received from M. Jules Lichtenstein respecting the rearing of the blister beetle, *Cantharis vesicatoria*.

Statistical Society, June 30.—Anniversary meeting.—Mr. G. J. Shaw-Lefevre, M.P., in the chair.—The report of the council, the financial statements of the treasurer, and the report of the auditors having been read, the chairman, in moving the adoption of the documents referred to, observed that the Fellows of the Society now numbered 746, and that the increase during the past year over the previous years, and as compared with the average of the last decade (509), indicated the steady progress of the Society. This was confirmed again by the increasing receipts from the sale of the Society's *Journal*. He congratulated the meeting on the satisfactory progress of the Society, financially and otherwise, during the past year. Thomas Brassey, M.P., was elected president. The chairman announced the subject selected for the essays in competition for the Howard Medal of 1880 (with 20*l*.), to be "The Oriental Plague, in its Social, Economical, Political, and International Relations; Special Reference being made to the Labours of Howard on the Subject."

ROME

R. Accademia dei Lincei, June 1.—Prof. Blaserna and MM. Casorati and Brioschi read a report on a memoir by M. Ascoli, on the representability of a function of two variants by double trigonometrical series.—Prof. Blaserna and MM. Felici and Betti read a report on a memoir by Prof. Galileo Ferraris on theorems on the distribution of constant electric currents.—Prof. Blaserna presented a memoir by M. Keller on the secular variation of the magnetic declination at Rome.—The following papers were read:—Contributions to etiology, by M. C. Emery.—Locomotion in the air, by M. Cordenous.—The application of photography to topographical operations, by M. Chizzoni.—President Sella spoke on a paper by M. Valle, a crystallographic study of some bodies of the aromatic series, prepared by Prof. Körner.—M. Lanciani made some demonstrations on malaria and on the subterranean roads in Rome and the Roman Campagna.—On the nature of the specific agent which produces fevers by malaria, by Profs. Tommaso-Crudelis and Klebs.—On the thermic and galvanometric laws of electric sparks produced by complete and incomplete discharges of condensers, by Prof. Villari.

PARIS

Academy of Sciences, July 7.—M. Daubrée in the chair.—The following papers were read:—Identity of *Bacillus amylobacter* and the butyric vibrion of M. Pasteur, by M. van Tieghem. The amylobacter, at a certain phase of development, produces a transitory reserve of starch, impregnating its protoplasm. That this occurs in solutions of dextrine or sugar, seems to have escaped the notice of M. Prazmowski and M. Pasteur.—On a new polygraph, an inscribing apparatus applicable to physiological and clinical researches, by M. Marey. He describes modifications by which his apparatus is rendered more portable, simple, and faithful in its indications. In his tambours, the elastic membrane is caught between two annular plates of metal; for transmission of sphygmograph movements he uses caoutchouc tubes rendered inextensible, &c.—On the origin of the excito-sudoral nerve-fibres of the face, by MM. Vulpian and Raymond. The cervical cord of the sympathetic probably contains few, if any, excito-sudoral fibres. The fibres in question come either from sympathetic nerve-fibres accompanying the vertebral artery in its ascending course through the transverse apophyses of the cervical vertebræ and (through these fibres) from the upper thoracic ganglion, or from the parts of the sympathetic coming from the rachidian bulb and the protuberance.—On the inundation of the town of Szegedin, in Hungary, by General Morin. A scientific account of the disaster. From data supplied by Prof. Krusper, of Buda-Pesth, it is shown that in less than fifty years, both as the natural effect of alluvia and that of embankment, the level of flood of the Tisza had risen two metres. General Morin points out the advantage of transferring the clayey and muddy deposits of the river from the lower to the upper parts of the valley, so turning marshes into cultivable land, and increasing the slope of the valley. With this view the dykes of the left bank might be gradually suppressed and replaced by submersible oblique dykes, furnishing successive basins for interception of material.—On the mean value of coefficients in the development of a skew or symmetrical determinant of an order infinitely great, and on doubly skew determinants, by Prof. Sylvester.—Application of sulphocarbonate of potassium to phylloxerised vines, by M. Mouillefert. He gives in a table particulars of the treatments effected by the General Society in the spring of this year. The sulphocarbonate is almost universally applicable for French vineyards, and can be used in any weather or any season without danger to the vine.—On the hypergeometric series and the polynomes of Jacobi, by M. Appell.—On the recent eruption of Etna, by M. Fouqué. The new eruption has produced, on the south-south-west, a fissure having only a few small crateriform apertures, and mouths of emission of lava slightly developed; but on the north-north-east side there are ten distinct craters, two of which are enormous (200 m. diameter, and 80 m. depth).—On the same subject, by M. de Saussure. He describes the phenomena in detail.—Evaporation of water under the influence of solar radiation through coloured glasses, by M. Baudrimont. Green and red, in general, favour the evaporation least, while yellow and red favour it most. M. Baudrimont considers there is probably a simple relation between the number and extent of the luminous waves and the number and extent of those which produce heat, in virtue of which they can be simultaneously propagated through a coloured glass and concur in the effect produced.—Thermo-chemical study of alkaline sulphides, by M. Sabatier.—On a new metal discovered by M. Tellef Dahll, by M. Hiortdahl. He has found it in a mineral composed of arseniuret of nickel (*kupfernickel*) and nickel glance at Oterö, a small island near the town of Krages. He calls it *Norvegium*. It is white, somewhat malleable, and hard like copper (Ng = 145·95).—On commercial trimethylamine, by MM. Duvillier and Buisine. It is not a simple product, as M. Vincent asserts; of trimethylamine there is only 5 to 10 per cent. in it. Dimethylamine dominates, being about 50 per cent. There are also monomethylamine, monopropylamine, and monoisobutylamine, in nearly equal quantities.—The charbon of ordinary onion (*Allium cepa*), a new disease, originating in America, and caused by an Ustilaginea (*Urocystis cepulæ*, Farlow), by M. Cornu.—Contribution to the physiology of local sweats; local action and antagonism of hypodermic injections of pilocarpine and atropine, by M. Straus.

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